A treatise on stricture of the urethra : containing an account of improved methods of treatment : with an appendix, on dilatation by fluid pressure in the treatment of urinary calculus and other diseases / by James Arnott.

A

TREATISE

ON

STRICTURE OF THE URETHRA,

CONTAINING AN ACCOUNT OF

IMPROVED METHODS OF TREATMENT;

WITH AN

APPENDIX,

ON DILATATION BY FLUID PRESSURE IN THE TREATMENT OF URINARY CALCULUS AND OTHER DISEASES.

BY

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PREFACE.

In publishing another Edition of this work, my objects are, to remove a misunderstanding about the origin of certain improvements in the treatment of Urinary Diseases which have been made within the last twenty years, and to correct an erroneous impression respecting the chief of these, which has prevented its general introduction into practice, although calculated to supply a great desideratum in this important department of surgery. My residence abroad, and other circumstances, have prevented an earlier attention to the subject.

The first Edition appeared in 1819, and about eighteen months afterwards, I published an Appendix to it, for the purpose of illustrating by a detail of cases one of the methods of treatment which had been proposed, and of drawing the attention of the public, (by an Essay on the subject) to the possibility of extracting stone

from the bladder without having recourse to lithotomy.

The surgical practices described in these works being as yet little understood, are employed to a very limited extent in England; but in the neighbouring country of France, some of them, by an extraordinary circumstance, became, in the course of a very short time, the established practices in the diseases to which they have reference.

At a Meeting of the French Academy of Sciences, in May, 1822, a report was read of a manuscript treatise on strictures of the urethra, which had been submitted to the Academy by M. Ducamp, a surgeon in Paris. This report was of the most favourable description, declaring that M. Ducamp's work "left them nothing to desire, and that they had no longer reason as regards its subject to envy their neighbours, the English" * * * "that he left the numerous and voluminous publications of other countries, on stricture, far behind him, by the soundness of his doctrines, the superiority of his practice, and his invention of instruments."—The natural consequence of such a reception by the highest scientific body in the kingdom, was, that M. Ducamp's book immediately be-

came the leading authority on the disease of which it treats.*

* "Peu d'ouvrages de médecine ont produit une sensation plus vive et plus générale que celui de Ducamp."—Lallemand, Des Maladies Genito-Urinaires, 1825.

The following are other extracts from the above report, which will be frequently quoted in the course of the work, as containing concise descriptions of the matters referred to.

"L'academie nous a chargés, M. Deschamps et moi, de lui rendre compte de l'ouvrage manuscrit que M. Ducamp, Docteur de la Faculté de médecine de Paris, a soumis à son jugement, sous le titre de *Traité des retentions d'urine causées par le rétrécissement de l'urètre, et des moyens à l'aide desquels on peut détruire complètement les obstructions de ce canal.*

Désirant remplir les vues de l'Académie, nous avons lu et relu avec une grande attention cet ouvrage, trop considérable pour qu'elle ait pu en entendre la lecture ; et comme il est qualifié de Traité, et qu'il concerne l'un des maux les plus redoutables, les plus communs et les plus douloureux de ceux qui affligent l'homme, nous n'avons pas cru devoir nous borner à un rapport ordinaire, et nous avons pensé que l'importance du sujet, ainsi que les développemens, la plupart nouveaux, que l'auteur lui a donnés, méritait que nous en présentassions une analyse un peu détaillée, en suivant l'ordre et la division selon lesquels il a été rédigé.

Lorsqu'il y a peu d'années, vos mêmes Commissaires eurent à s'expliquer sur un Memoire relatif à la même matière, et dont il vous a été fait également hommage, ils ne manquèrent pas de louer le zèle et les efforts de son estimable auteur (M. Petit) ; mais ils ne purent dissimuler l'imperfection de ses procédés, presque entièrement empruntés ou

That the methods of treatment brought forward by M. Ducamp on the above occasion as his own inventions, were the same that I had described in the first Edition of this treatise two years before, and that he was acquainted with my work soon after its publication, will be evident from the following observations.

The improvements described in my Treatise on Strictures had respect, first, to the treatment of very narrow, or, as they have been called, *im-*

imités des Anglais, et ils exprimèrent le vœu, ou qu'il remît bientôt la main à son écrit, ou qu'un autre s'emparât du sujet, bien convaincu que l'art et l'humanité avaient besoin de moyens encore plus féconds et plus efficaces que ceux qu'on proposait à l'Académie. * * * Ces derniers mots vous font assez connaître la haute opinion que nous avons conçue de l'ouvrage de M. Ducamp, et le cas particulier que nous faisons de l'auteur, lequel nous a loyalement et franchement initiés à ses opérations, et rendus témoins de plusieurs dont les suites ont été complètement heureuses. Nous pensons, tout en rendant justice aux hommes recommandables qui l'ont précédé dans la carrière qu'aucun n'y a déployé autant d'industrie, d'addresse et de talent; il nous semble même qu'il serait pour le moins très difficile de faire mieux et de découvrir un mode de traitement plus court, plus simple, plus certain, plus raisonnable, et nous estimons que M. Ducamp a acquis des droits réels à la confiance des malades et à la reconnaissance des gens de l'art et que son ouvrage mérite les éloges de l'Académie. *Signe*, DESCHAMPS; PERCY, Rapporteur;—CUVIER, Secrétaire Perpetuel.

permeable strictures, and to cases of retention of urine from stricture; secondly, to effecting such a degree of dilatation of stricture as completely to remove it; thirdly, to obtaining the same result, and other beneficial effects, by a method of applying caustic exclusively to the diseased part; and fourthly, to a means of more speedily dilating stricture, and with less irritation, than could otherwise be done.

1st. From reflection on the various causes of difficulty in passing instruments through strictures, several new modes of surmounting these had been contrived and were described in my work. Two of these plans are to be found in M. Ducamp's book, and are noticed in the sequel at pages 71 and 75. Some of the remaining proposals have been since adopted, particularly by the French.

2nd. The difficulty of permanently removing strictures by dilatation, arises from the circumstance, that the orifice of the urethra is narrower and less distensible than any other part of it, and that it may be often necessary to dilate the morbid part even beyond its natural diameter, so as to remove the disposition to contraction. As this cannot be accomplished by an instrument unchangeable in its di-

mensions, the idea occurred of substituting one which might be increased in size while within the constricted part, and after dilating this, be again diminished so as to permit its easy extraction. A strong, thin, membranous tube, rendered air-tight by prepared gut or caoutchouc, in order that it may be distended with fluid, perfectly answers this purpose, and has, besides, other advantages, as compared with the common instruments of dilatation, scarcely of less importance.——The reasonings in M. Ducamp's book upon the desideratum in the cure of stricture by dilatation, and his mode of supplying it, are precisely similar to these (see p. 100.)

3rd. But although the bougie or catheter may not be deemed adequate, caustic can be so applied as completely to destroy the obstruction; and undoubtedly many permanent cures have been thus accomplished, and the patients thereby saved from the constant hazard and eventual mischief of a protracted irritation of the urethra. The objection to the use of caustic arose from the bad, and occasionally fatal consequences of its action not being confined to the diseased part. In studying how to obviate such dangers, it occurred, that the caustic ought to

be applied to the *channel* of the stricture, or be conveyed within it, instead of being applied to its anterior surface or *face;* and that in order more certainly to limit the action of the remedy, the extent of the stricture must be previously ascertained. Means of accomplishing both of these ends were described in my treatise, and instruments contrived on precisely the same principles are proposed in the work of M. Ducamp, (see pages 155 and 158)*

4th. But it was not only in the first and last stages of the treatment, that improvement was required. When a stricture easily admits an instrument, it may still be found unyielding to bougies or sounds, because its hardness and extent may render the force required to overcome it dan-

* M. Ducamp's miscouception respecting the construction of the fluid dilator, limited his practice to the use of caustic; which, however, was so great an improvement on the common means of treatment by bougies and catheters, as to have appeared to the French Surgeons all that was to be desired. "Les travaux qui ont eu pour résultat l'application rationelle du caustique au traitement des coarctations urétrales ne remontent pas au-delà des combinaisons instrumentales imaginées par Ducamp." * * * "La Méthode de la cautérization lui est redevable de si heureux perfectionnements, d'une sureté si grande, d'une popularité si universelle, qu'on peut sans injustice lui en attribuer la veritable création."—Dictionnaire de Médecine et de Chirurgie Pratiques, Tom. xiv. 1835.

gerous, when exerted by instruments that operate as the wedge, by reason of their forward motion in the act of dilatation. This defect of the common measures was to be remedied by an instrument that should act from the centre directly outwards; and the same means fortunately, that gives the capability of dilating the diseased part to any extent, also supplies this desideratum. Even when strictures are not so resisting, there are several other defects in the remedial action of bougies and sounds, as compared with the fluid dilator, by which the suffering of the patient is increased, and the treatment prolonged. It was, therefore, a great misfortune that M. Ducamp, from misunderstanding the principle of the construction of the instrument, and by recommending a modification of it perfectly inefficient, except in some rare cases, prevented its adoption; and this was still more to be regretted, as dilatation by fluid pressure might have been extended with the greatest advantage to the treatment of stricture of the rectum,—enlargement of the prostate gland—urinary calculus—and other diseases. I hope that the subject has been explained in this Edition in such a manner as to prevent the possibility of any future misconception.

The instruments proposed by M. Ducamp as his own inventions are constructed on precisely the same principles as those described in my treatise, but differ in mechanical arrangement. As it is obvious that these principles may be carried into effect by a variety of modes, it is unnecessary (assuming that M. Ducamp was acquainted with the original proposals) to explain why mere modifications of the particular methods which I recommended, would not entitle their contriver to much credit, even were the alterations considerable improvements, which, as will be seen in the sequel, is far from being the case in the present instance. But modifications may be contrived for another purpose than improvement—for the purpose of concealing their origin.

It may be said, however, that the similarity between the proposals of M. Ducamp and those contained in my publication, is no proof of their want of originality, as similarity may be shown to exist between what have been deemed the greatest discoveries or inventions in the medical art, and former suggestions, or well known facts. The difference between the cases will be evident by adducing a few instances of

such inventions. It will appear by these, that even should the inventor have been aware of some previous suggestion or known fact that resembled his own improvement, he converted into a valuable expedient, by the discovery, and explanation of its principle, and the extension of its application, what was before, but an useless chance suggestion, unappreciated by him who made it, or a fact from which no important inference had been drawn. Nevertheless, it is true that the credit of originality has been denied to the most important improvements on this account. Hunter's greatest practical addition to surgery—the operation for aneurism, has been called the invention of some French or Italian Surgeon, who without understanding the principle of the proceeding, or appreciating its importance, chanced to perform a similar operation.——Jenner, it has been asserted, is not the discoverer of the preventive efficacy of cow-pox, or of vaccination; and there is ground for the assertion; yet the same fact or tradition, from which the inquiries originated that terminated in the discovery of the efficacy and vast importance of this preventive, and in the contrivance of a means of propagating it to the extent required, was pre-

viously known to very many medical practitioners, who saw nothing in it worthy of investigation.——Laennec, we have been told, took the idea of auscultation in disease from a passage in Hippocrates, and assuredly, it was known and had even been practised long before his time; but his due appreciation of it, and his extension of the practice by the contrivance of an instrument for the purpose, having converted into a highly useful means of diagnosis that which was before of no value, and with which most practitioners were perfectly unacquainted, fairly entitles him to all the credit of being its discoverer.——With equal justice, (to descend to an improvement of comparatively humble pretensions,) the originality of the principle may be contested on which the instrument described in this work called the dilator, is constructed. Dilatation by fluid pressure, though not practised, was not altogether unknown in surgery; but its importance had not been discovered, its power and the extent of its applicability were not understood, nor had an instrument by which it might be easily carried into effect been contrived.—It is indeed scarcely possible to name an invention to which something similar had not been produced in

former times; but there is a wide difference between the circumstances of such instances as have been adduced, and those of the case under consideration. The principles of treatment proposed by M. Ducamp, were precisely those which I had proposed only two years before; and an equally high estimate of their value had been formed in my publication.

Yet, as there is a possibility of the same ideas (however numerous and diversified they may be) occurring independently to two persons who by some accident may be engaged at the same time in the same enquiry, it is proper, in adopting a different explanation of the case before us, to bring evidence in proof that M. Ducamp was acquainted with the publication which contained an account of what he afterwards proposed as his own inventions. Of this description are the facts—that he was not only conversant with English literature, but was a translator of cotemporary English medical books—that he quotes in his work on stricture, the principal English writers on the same subject, as Hunter, Sir Everard Home, and Sir Charles Bell,—and that although he makes no allusion to my *first* work, which contained the descriptions of the practices in question, he refers to my

second publication, which contains allusions to the first. But the most decisive evidence of his acquaintance with that work is the following : my treatise on stricture was noticed in the Medico-Chirurgical Review for October 1819, in terms calculated to attract to it the attention of one, whose principal engagement at that time appears to have been the introducing of English Medical literature and practice amongst his countrymen ; it is recommended as being " not only the best systematic work on the subject in the language," but as containing descriptions of important improvements in the treatment of stricture and stone ; and in a list of the new subscribers to the Journal, at the end of that Number, there occurs the following entry, " Ducamp M. Docteur en Médecine, Rue St. Martin, à Paris."

I trust that the republication of this work, and the correction of the erroneous opinions respecting one of the plans of cure recommended in it, will be instrumental in improving, in this country, the treatment of these diseases, which still continues below the level of most other departments of British surgery. Notwith-

standing the general admission, that irritation in the urethra, which is the unfailing attendant on its permanent contraction, has a tendency to spread to other organs of the urinary and generative systems, and that it actually does so extend, with the worst consequences, in a great many cases, the treatment of stricture is rarely undertaken with the hope of effecting a complete or permanent cure. The disease, in most instances, is deemed incurable; and whoever reflects upon its nature, and the mode in which the instruments usually employed in its treatment operate, must be convinced that it cannot be cured by such means.* Even as

* Hunter, speaking of the cure by dilatation, expresses himself as follows: "No man who has ever had a stricture and is cured of it should rely on the cure as lasting, but should be always prepared for a return, and should always have some bougies by him. He should not go a journey even of a week without them, and the number should be according to the time he is so absent."——M. Delpech, writing on the subject some years before the introduction of an improved practice into France, and when the mode of treatment was similar to that still in use in England, observes, that "privés d'un traitement méthodique et radical, nous ne pouvons recourir qu'a des procédés empiriques et palliatifs, dont les effets ne sauraient être durables, et se bornent à prévenir ce degré de retrécissement où la rupture du canal et l'épanchement, de l'urine deviennent inévitables." Precis Elémentaire des Maladies Chirurgicales, 1816.

palliatives, the common measures are far from being successful in every instance ; they are, besides, always tedious, and sometimes severe and even dangerous. * The conviction of the insufficiency of the usual means of cure by dilatation, led to the general employment of the caustic bougie in stricture, and to the violent use of the sound or catheter—a change, which, from the obviously dangerous character of these practices, marks very expressively how important a permanent cure was deemed by those who adopted them, and how many hazards it was reckoned justifiable to incur in the attempt to accomplish this, rather than leave the patient's

* The practice of dividing stricture by the knife, which is almost the only change that has taken place in its treatment of late years in England, not only furnishes an example of such severity and danger, but is also strikingly illustrative of the unsettled state of opinion respecting the management of one of the forms of this disease. The French, with whom this practice, under the name of *boutonnière*, was in former times not uncommon, now speak of it in such terms as the following : "Je ne sçais ce que l'avenir destine à ce procédé, chez nos voisins, mais j'espère que des tentatives aussi déraisonnables et qui font si manifestement rétrograder l'art vers les époques les plus barbares de son enfance, ne trouveront d'imitateurs parmi les chirurgeons éclairés et habiles de notre pays."—Dictionnaire de Médecine et de Chirurgie Pratiques, Art; Uréthrotomie, vol. xv. 1836.

health to be undermined by an insidious and a lasting disease. Such immediate and often fatal effects of stricture as retention of the urine and its extravasation from rupture, may generally be prevented by the prudent conduct of the patient; but the diseases of neighbouring organs, produced by irritation of the urethra protracted through a long series of years, will certainly imbitter the close of life, if they do not shorten its duration.

As this work was intended to be a comprehensive treatise, every kind of practice in stricture, which may under any circumstances prove useful, is described; for a disease of so varied a character frequently requires a variety and combination of expedients in its treatment. Some of these practices the reader will find more fully treated of than others, and particularly that of dilatation by the new instrument for effecting fluid pressure. Conceiving that its use constituted the best and most generally applicable treatment, I was desirous to obviate, by clearness and completeness of description, the objection (which nevertheless has been made) that the instrument is complex and of difficult application. If the Surgeon be

made acquainted with the value of this means, he will not be prevented from adopting it by such an objection, or by the little additional study which it may require to use the instrument dexterously.

The principal purpose of the Essay which I published on Urinary Calculus, was to rouse the attention of Surgeons to the fact, that the painful and dangerous operation of lithotomy might be superseded by measures of a different character; and, as satisfactory evidence of this, there were recorded in it the details of an operation, then unprecedented in the modern annals of surgery, by which a stone of considerable magnitude had been extracted without cutting. The connection which the facts and suggestions in this Tract had with the improvements in the treatment of calculus which immediately followed, has been considered in the Appendix. Had the nature of my professional engagements yielded better opportunities for observation connected with Urinary Calculus, (which is a rare disease in tropical climates,) I have little doubt that I should have been able, long ere now, to have proved by further experience the superiority of the method proposed in that Essay of extract-

ing stone by slow dilatation.* I trust that my long continued silence upon this proposition, as well as upon others contained in the same publication, will not be ascribed to any change of opinion respecting their value, or to indifference about such inquiries. On the contrary, although from the nature of my public office, other medical inquiries have, of late years, engaged more of my attention, there is no class of diseases which I consider of greater importance, or more worthy of investigation, from their frequency and the distress occasioned by them, than those of the Urinary Organs. And

* Since writing the observations at page 199, on the ingenious method invented by Sir Astley Cooper for removing calculi from the bladder without cutting, and which combined the operations of finding the stone and opening a passage for it, I have learned from Sir Benjamin Brodie's work on Calculous Diseases, that stones of considerable dimensions have been removed by a modification of this plan of *quick* dilatation—a fact which I am glad to adduce as another striking evidence of the dilatability of the posterior part of the urethra. This eminent Surgeon succeeded, on two separate occasions, in extracting a calculus of considerable size from the bladder of an elderly gentleman, as far as the membranous part of the urethra, from which it was then removed, without danger, by an incision in the perinæum. The dimensions of one of these stones was $\frac{7}{8}$ths of an inch in one diameter, and $\frac{6}{8}$ths in another.

being again (in consequence of certain alterations in the affairs of the East India Company) where the necessary opportunities offer, I shall hope to prosecute the subject, until the improvements alluded to, be perfected.

As it is a principal object of this republication to claim priority with respect to certain surgical improvements now practised in France, I have thought it best to reprint the first Edition without any change beyond a few verbal corrections, where greater clearness was desirable, or a few omissions of unimportant matter; and in the passages describing the improvements of which the priority is claimed, even these slight alterations have been avoided. Whatever was required, in addition to its former contents, to render the treatise as complete as I can make it, has been appended in the form of notes distinguished by a bracket, either at the bottom of the page, when immediate reference was desirable, or at the end of the several Chapters and Sections.

It only now remains, that I should notice a complaint which has been made of an omission in the first Edition, by a member of the profession, whose rank in it entitles his observations to

attention. Before publishing a description of the new instrument for dilating by fluid pressure, it was thought desirable fully to ascertain its effects in strictures of various kinds; and with a view to this, application was made to Mr. Guthrie, on account, I believe, of his connection with military hospitals, which, it was supposed, would furnish the opportunities desired. Mr. Guthrie has stated that, on this occasion, he suggested improvements in the construction of the instrument, of which no acknowledgment has been made in my publication. Now, as he makes no pretensions to having invented the essential or characteristic part of the instrument, namely, a strong membranous tube impermeable to an injected fluid, it is difficult to see what remained in its construction worthy of such a claim. The idea of the perfect instrument had been formed before any application was made to him, and all that remained was to ascertain the proper materials and most suitable forms for different cases, which must have been done by any one who had the necessary opportunities. To those who happen to be acquainted with the history of this invention, and who are aware of the various improvements that have emanated from the same

quarter, it would appear not a little singular, that it should have been left to Mr. Guthrie to suggest whatever mechanical arrangements were necessary to the perfection of the instrument. The apparatus which I myself have generally used, and which is described in the following work, has acquired its present form by degrees, as objects presented themselves which it was necessary to attain; but a variety of forms may probably be contrived which might answer nearly as well. For instance, amongst other modifications which I have thought it unnecessary to notice, instead of the central movable wire of the instrument, I have, in certain cases of wide and extensive stricture, used a catheter of the smallest diameter, to which another tube is soldered for conducting the distending air.

But if, after the invention of the essential part of this instrument, there remained nothing of importance in its form or construction for Mr. Guthrie to claim, there might still have been merit from extending its use, by propagating with care a knowledge of its mode of action, which some pains had been taken to point out to him, as he thereby would have greatly prevented the misconception that has so gene-

rally been entertained on the subject. It might, at least, have been expected, that one who could claim the priority of such suggestions as those of the best point for the instrument, or the best material for its conducting tube, would have shown a proportional estimate of its value, and not have spoken of the difficulty of making or preserving the fluid dilator, as a reason for his not employing it.

21, *Fitzroy Square*,
Nov. 13, 1840.

CONTENTS.

APPENDIX.

CHAPTER I.

OF THE URETHRA.

As correct ideas of the Anatomy and Functions of the Urethra are essentially requisite to the understanding of its diseases, I introduce the systematic consideration of Strictures, with a sufficiently minute account of these. I am the more inclined to such a commencement, because former writers on stricture have contented themselves with general remarks on the anatomy of the urethra, referring the reader to professed anatomical works for further, though not less necessary information; and because of the controversy still subsisting respecting its muscularity—a point of great importance, to which I have paid proportional attention, and which I trust will be now no longer a subject of doubt. At the same time, then, that the uninformed, by the perusal of this introductory section, will be saved the trouble of searching into books of anatomy, the more advanced in the profession may not find it unworthy their

pains, by glancing over the following details, to refresh their memory of the anatomy of an intricate part, important as the seat of frequent and obstinate disease.

The urethra is the canal by which the urine flows from the bladder. It is short and simple in the female, where it serves that purpose only; but long and with complicated relations in the male, where it has a most important additional office as the conduit of the seminal fluid in the act of generation. It is rarely the seat of morbid affection in the female; but in the male, its diseases, and those of the parts intimately connected with it, are more frequent and distressing than any other class in the table of human sufferings.

The male urethra, then, becomes the chief object of our study. It reaches from the bladder to the extremity of the penis, and when extended, is about nine inches in length. It arises from that part of the bladder which in the erect position of the body is the lowest, and may be considered a tubular continuation of its inner coat; from thence, describing the arc of a circle downwards and forwards for two and a half inches, it passes out of the pelvis in the angle of the gothic arch formed by the ossa pubis, and enters the penis, which begins at this part to

run along its length. The penis, at its commencement, is suspended by ligamentous fibres from the front of the pubis, and consists of three cylindrical bodies, kept together by an appropriate sheath or covering, viz. the two corpora cavernosa forming the upper part or dorsum penis, and the corpus spongiosum enclosing the urethra, lying in the groove of these two, and forming its lower part. The corpora cavernosa come like roots, one from each side of the arch of the pubis just alluded to, to unite at the symphysis pubis, and to receive there the corpus spongiosum, which enclosing the urethra, comes directly from within. The urethra, till it enters the penis, being connected with fixed parts, can suffer little change in its curvature or dimensions,—an important recollection to the surgeon,—but in the penis, it lengthens and shortens with it, and shares in all its motions.

For the sake of perspicuity in their descriptions, Anatomists have given distinct names to three portions of the urethra. The first, continuous with the neck of the bladder, and of about an inch in length, they have called the prostatic portion, because it is surrounded by the prostate gland, a solid conoid body, about the size of a chestnut. The second, which is also about an inch in length, is called the

membranous portion, because the membranous tube of the urethra is there unprotected but by muscular fibres surrounding it, and the common cellular substance. The third is called the spongy portion, because embedded all the way in its thick sheath the corpus spongiosum, which it enters as it approaches the arch of the pubis. This spongy texture has a bulbous form where the urethra enters it, from which circumstance, that part is called the bulb of the urethra; it is then nearly cylindrical until near its end, where it again expands to form the glans penis, giving a covering to the extremities of the corpora cavernosa, and completing the form of the member.

The first portion in passing through the prostate gland adheres closely to it, and is connected by the anterior and upper surface of this, through the medium of cellular substance, to the posterior surface of the pubis, and on the other side, through the same medium, to the rectum or great gut. On the under side of this portion, and within, there is a longitudinal ridge, named caput gallinaginis, from its fancied resemblance to the head of a woodcock; it lessens towards each end, and its anterior extremity, dwindled into a slightly rising line, may be traced as far as the bulb. About the sides of the caput gallinaginis, several small excretory ducts

open, two larger than the rest, the ductus ejaculatorii, and the others of the same nature belonging to the prostate gland.

The only points to be attended to in the anatomy of the membranous part of the urethra, besides what have been already mentioned, are these; that it is the narrowest portion of the canal, especially where it enters the bulb;—that it passes through a slit in the funnel-shaped muscle, called the levator ani and is liable to be closed by it;—and that, like the prostatic division, it is situated between the pubis and extremity of the rectum.

The anterior or spongy portion, constituting three-fourths of the whole length of the canal, is chiefly remarkable for the numerous lacunæ or small mucous follicles, which are placed obliquely in its substance opening forwards—and for the openings into that part of it which is sometimes termed the bulbous portion, of the short ducts of two pea-sized glands, first described by Cowper. Longitudinal rugæ or wrinkles are observable on its inner surface when in the collapsed state.

Little difference exists between the diameters of different urethræ, and as Sir Everard Home has already published accurate measurements of the widths of the several parts of the canal, taken from

waxen casts, not to multiply authorities, I shall transcribe the principal of these.

The inch is divided into 20 parts.

At $\frac{3}{4}$ths of an inch from the outer extremity of the urethra, its diameter is	$\frac{9}{20}$ths.
At $4\frac{1}{2}$ inches down	$\frac{7}{20}$ths.
At the middle of the bulb	$\frac{12}{20}$ths.
At the membranous part directly beyond the bulb	$\frac{7}{20}$ths.
At the middle of the prostatic portion	$\frac{11}{20}$ths.
At the orifice of the bladder	$\frac{9}{20}$ths.

Home observes that the largest bougie he had ever employed being only 5-20ths of an inch in diameter, was consequently 2-20ths less than any of the above dimensions.

It appears from the above scale, and from observations made by other anatomists, that the orifice of the urethra is narrower than any part of the canal; that about 3-4ths of an inch from this, it is considerably dilated, forming what has been called the fossa navicularis; that the average width of the moderately stretched urethra, and which is preserved with considerable accuracy from this fossa to the bulb, is about the third of an inch; that at the bulb it is enlarged more than at any other part for about the

space of an inch; that immediately behind this, it is more contracted than at any other part, which in addition to other circumstances, accounts for the frequent occurrence of strictures at this point; and that a third dilatation is found in the middle of the prostatic portion.

The inner coat of the urethra possesses equal elasticity with other resembling textures, but greater vascularity and sensibility; and these latter qualities predominate chiefly about the bulb. Irritation of this sensible membrane by the acrid urine is partly obviated in the fore part of the canal, by the bland mucus excreted from the follicles above mentioned, and in the further part, the secretion from the prostate and Cowper's glands may afford the same protection. What has been described as the outer coat of the urethra, is nothing but the condensed cellular membrane which connects the inner or mucous coat to the surrounding parts, requiring therefore no particular description.

The most material point regarding the structure of the urethra is, whether it possesses that power of contraction and relaxation which we observe in muscular tissues. The profession are still divided in their opinions on this subject; some asserting that several phenomena of the urethra, as well as

other circumstances, clearly demonstrate this power; while others deny its existence, because they have not discovered fibres in the texture, and attempt to explain the phenomena on other principles. As it is of great importance for the management of stricture, that the question be decided, I shall review the facts and arguments.

First: a bougie introduced four inches into the urethra, will sometimes remain there quietly, and may be withdrawn as easily as it was introduced; sometimes it will be thrust out again with greater or less force, and sometimes will be firmly grasped and retained. Those who assert that the urethra possesses muscularity, account these phenomena alone sufficient proof of their opinion; holding that, in the one instance, the bougie is gradually expelled by the successive contraction of the muscular fibres against its point, as when a substance is moved forwards in the intestine by its muscular action; and in the other, that the bougie is retained by the contraction upon it of the circular fibres which it distends.—Those, on the other side, who deny the muscularity, attribute these phenomena to simple elasticity of the urethra.

Now although elasticity, by grasping the bougie, might retain it when passed far into the urethra,

because the pressure and friction upon its sides would act more strongly to retain it than the effort of the same degree of elasticity on its extremity would to expel it; or might expel a very short length of bougie from the orifice of the canal, because there the action of the elasticity on the end would be superior to the obstacle of the friction on the sides; still in the case of a bougie pushed out when far in the canal, uniform elasticity cannot be the agent, as then more force must be exerted on the extremity than on the sides. When the end of a bougie lies in the bulb surrounded by the ejaculator seminis muscle, we see it expelled by that muscle as the urine or semen is, which no one denies to be a muscular phenomenon; and the same thing happens, though in a less degree, in the anterior part of the canal. As this fact then clearly proves that the part of the urethra at the point of the bougie acts with greater force than the part which surrounds its length, it proves at the same time that contractility, quite distinct from elasticity, must be exerted.

Secondly, in an irritable state of the urethra, as in gonorrhœa, the stream of urine is often suddenly obstructed or stopped, by a temporary contraction of the canal. This, in the fore part of the canal, where

there are no exterior muscular fibres, may be produced either by muscular contraction of the urethra itself, or by its lining membrane becoming suddenly gorged with blood, but cannot be caused by elasticity. The same thing happens in permanent stricture of this canal, which is often suddenly increased, causing retention of the urine, and preventing the passage of the smallest instrument, and yet quickly yields to means of an antispasmodic nature.

Thirdly, in cases of stricture in the anterior part of the urethra, a bougie will be passed, and will remain for some time in the part without exciting pain, and be easily moveable backwards or forwards. Suddenly, however, a sharp pain will be felt, and on attempting to withdraw the instrument, it is found to be firmly grasped. On forcible extraction some minutes after, the bougie will be found strongly marked, as if a thread had been tied tightly round it. No satisfactory explanation can be given of this fact, but by supposing the fibres of the urethra separately contractile, for elasticity would act at once and equally upon the whole surface of the bougie, and the gorging of the blood, above mentioned, could scarcely be confined to so limited a space.

Fourthly, the existence of thread stricture is inexplicable on any other supposition, than that of

the contractility of the distinct fibres. The objection that strictures would always be completely circular, if caused by contraction of muscular fibres surrounding the canal, instead of being only segments, or projections occupying but one side of it as is sometimes the case, is untenable; for the fibres, although muscular, may not be complete circles, two or more being required to complete a circle.

Fifthly, although in the human urethra the fibres cannot be distinctly shown, still in larger animals, the horse for instance, they are very evident, and as the part performs the same functions in both animals, we may reasonably suppose the analogy of structure to hold as well as the analogy of function; and other animal structures might be mentioned which evidently possess a power of contraction and relaxation, without the appearance of fibres in their texture.

These facts prove satisfactorily the contractility and fibrous structure of the urethra, and these are the points which it is of importance for the Surgeon to know.

Whether the contractile fibres of the urethra should be called muscular fibres, is a matter of very little moment; though this seems to have been a chief point of dispute between those who have taken

different sides of the question regarding its structure. The contractile fibres of the intestines and great arteries differ amongst themselves, and from voluntary muscles, in several of their properties, and yet all are called muscular, because of their contractility. The urine and semen are expelled from the back part of the urethra by muscles surrounding it, and acknowledged by all parties. In the fore part of the canal, this effect must be produced either by contraction of the urethra itself, or by the pressure of the corpus spongiosum surrounding it; and it is probable that both causes operate.

[Opinions still remain divided with respect to the contractility of the urethra, notwithstanding the minuteness with which every question regarding its structure and functions has been investigated during the last twenty years. In a paper in the Philosophical Transactions for 1820, Sir Everard Home expresses the opinion, founded on Mr. Bauer's microscopical observations, that there is a continuity of bundles of short muscular fibres surrounding the urethra, but

having a direction in a line with its axis, instead of being transverse, as he had previously supposed. These observations, however, have not been confirmed by subsequent inquirers, or at least other explanations have been given of the same appearances.

This inquiry, which may have appeared to the reader of a disproportionate length, is important from its connection with the theory of the formation of stricture in the urethra, the opinions respecting which have very much guided Surgeons in their methods of treating it; but whether contractility inherent in the urethra be admitted or not, it is highly necessary for the Surgeon to be aware that the obstruction to the passage of urine or any other foreign body through the canal often comes on suddenly, and that such impediment is the result of causes that usually excite spasm, and may be removed by antispasmodic remedies; although as regards the posterior part of the urethra, which is indeed most frequently the seat of the obstruction, the muscles which are in contact with it, but form no part of its substance, may, on such occasions, be alone affected.

The most frequent seat of stricture is at the junction of the membranous and spongy portions of the urethra. It must be borne in mind, however, that

there is at this point a combination of the following natural impediments to the passage of instruments. The urethra passes through a narrow opening in the triangular ligament which fills up the arch of the pubis ; there is immediately in front of this ligament a depression or pitting in the lower surface of the channel ; there is a considerable bend in its direction ; and a peculiar disposition to closure from muscular contraction, owing to the natural irritability of this part of the urethra, and the complicated muscular structure in connection with it. A recollection of these circumstances will not only go far to obviate the mistake of attributing to disease an impediment that is natural, or which may arise from the operator's want of skill or dexterity, but tend also to prevent such injury from the improper direction of the instrument, or degree of force employed in passing it, as may in itself be the cause of stricture. The danger of the last occurrence is greater if inflammation or irritation already exist in this part of the canal.

There is not only considerable difference amongst individuals in regard to the length of the urethra, but Anatomists are by no means agreed as to its average or usual length. Too little attention has

been paid, while ascertaining this point, to the degree of extension to which the urethra is subjected at the time, either artificially or by the natural distension or erection of the penis. A practical remark of some importance may be drawn from this cause of uncertainty, viz. that in determining the length to which instruments should be passed, it is advisable to rely on the sense of touch as well as on previous measurement, or to allow one of these means to check or correct any error that might proceed from the other. From erroneous estimates of the length of the urethra, it has happened that the bladder has been pierced or otherwise seriously injured by passing instruments too far; and, on the other hand, the worst results have ensued from its not being relieved in retention of urine, in consequence of the attempt having been made by a catheter of only the usual dimensions in cases where disease of the prostate gland had elongated the canal.

The several parts of the urethra differ from each other in respect to their distensibility. That of the portion nearest the bladder is lessened by its connexion with the prostate gland, though not to the degree that has been generally supposed; for in many cases, according to the observations of certain

French Anatomists, the gland is found not to surround the urethra completely, but to leave about a third of its upper surface uncovered; and in almost every instance where it is so surrounded, the channel passes much nearer to the upper than the under surface of the gland. The membranous portion is exceedingly dilatable, and particularly by natural causes, as the force of the obstructed flow of urine in cases of stricture, and the increasing size of calculi lodged within it. The spongy portion of the urethra has not generally been considered so dilatable as the membranous portion, but this opinion may have arisen from the same extent of distension not having been observed in consequence of this part not being so subject to the natural causes alluded to, as strictures are generally situated at its posterior extremity, and calculi are usually stopped in their progress outwards by the barrier of the triangular ligament. The ligamentous substance surrounding the comparatively narrow outer orifice renders it less dilatable than any part of the canal. We shall see, in the course of the work, how important the subject of the dilatability of the urethra is, particularly with reference to the permanent cure of stricture, and the means of artificially dilating the canal in order to extract calculi from the bladder.

The strength of the urethra, or power of resistance to instruments pushing against it, is not the same throughout the canal. The name of the membranous portion may mislead in this respect, for the muscular tissue and condensed cellular substance with which it is surrounded make it more resisting than the portion anterior to it. The usual seat of breach from instruments is the bulbous portion, which is comparatively weak, and is exposed besides to injury from the natural and morbid impediments to the passage of instruments occurring at this part. More in front, the upper part of the spongy portion receives support from the corpora cavernosa ; and the Surgeon should take advantage of this fact in the operation of passing the catheter.

The project of piercing calculi in the bladder by circular saws or drills, for the purpose of facilitating their extraction, or the application of solvents, soon led to a knowledge of the fact, that notwithstanding the urethra has naturally a double curve in its course, which has been compared to the letter S, still, from the slight degree of this, and the distensibility of the parts with which it is connected, the Surgeon may pass a straight instrument into the bladder without difficulty. The possibility of doing this, it has been ascertained,

was well known to the ancients; but for the revival of the practice, and its application to one of the operations of Lithotrity, we are indebted to M. Gruithuisen of Bavaria, and M. Amusat of Paris.

CHAPTER II.

OF THE NATURE OF STRICTURE OF THE URETHRA.

A DIMINUTION of the diameter of the urethra from disease of its coats, is termed a stricture.

With a view to practice, it becomes very important to distinguish different kinds of stricture from each other. They are conveniently classed: first, with reference to their contractility and structure; secondly, with reference to their dimensions.

In the first class, Mr. Hunter distinguished the spasmodic, the permanent, and the mixed; the last consisting of a combination of the other two; and subsequent writers have described an inflammatory and an irritable stricture. With reference to their dimensions, we shall have to consider the wide and narrow, the long and short stricture.

The *spasmodic* stricture depends entirely on excessive or spasmodic contraction of some of the urethral fibres, and exists no longer than that contraction continues.

The *permanent* stricture depends altogether upon a change of structure in the narrow part.

In the *mixed* stricture there is change of structure, conjoined with spasmodic action of the fibres.

These three varieties are often the different stages of the same case. A simple spasm of the fibres may first occur, giving alarm from the retention of urine which it causes; but on again subsiding, may leave the parts in their natural state. If the spasm continue longer, however, the natural consequence will be inflammation, and the deposition of coagulable lymph. This will cause the sides of the obstructing duplicature to adhere together, and the return of the parts to their natural situation is no longer possible. This state would be called the mixed stricture. Again, by the continuance of the inflammation just described, the contractile fibres may be so altered, and their sensibility so diminished, as no longer to be liable to any sudden change; and this constitutes the true permanent stricture.

Strictures are generally both permanent and spasmodic, or liable to increase from spasm, and of these, unless it be otherwise stated, I wish to be understood as speaking in the future course of this Essay.

Mere inflammation of the urethra, as it diminishes the capability of distension, and by thickening its

substance, narrows the canal, may be as properly reckoned a temporary species of stricture, as the pure spasmodic affection; and a chronic inflammatory state of the urethra, well known as a consequence of gonorrhœa, must be regarded moreover as a frequent cause of permanent stricture.

It is of material importance to the patient, that he should be made acquainted with the liability of stricture to spasmodic aggravation of contraction; for by avoiding the causes of this, he will escape the more sudden and alarming dangers of the disease. The caution is less necessary in old strictures; but in more recent ones, the irritability is frequently so great, as to render the passage of the urine, or of any extraneous body through the stricture, exquisitely painful; and then the slightest causes of spasm are to be feared. Strictures under this state have appropriately enough received the epithet of *irritable*.

To Mr. Hunter we owe the first accurate account of the most important particulars regarding the nature of stricture, and the value of our information on this head may be appreciated, when we reflect, that chiefly to the vague and erroneous notions of the older Surgeons, as to the nature of stricture, may be traced their inefficient and frequently dangerous methods of treatment.

Strictures, with reference to their dimensions, are distinguished, as above stated, into *wide* and *narrow* varieties, according to the diminution of the canal; and depending chiefly on the time that the stricture has existed. They become gradually narrower, with a progress proportioned to the irritation present; but as the urine must always have a passage, complete organic obstruction is only found where fistula in perinæo has opened to the urine a new channel. Sometimes the obstructing fold, or thickening of the membrane, is an arc, or occupies only a part of the circumference of the passage, and then generally the under side; and even, as in common cases, where it arises from all around, this may not be equally, or, in other words, the opening through it may not correspond with the centre of the canal.

The terms *long* and *short*, applied to stricture, regard the length of the canal occupied by it, a circumstance on which the particular method of treatment to be pursued, often depends. Long strictures have also been called *ribbon* strictures, because the urethra appears as if a ribbon were tied round it; the extent may be a quarter, half, or whole inch, or more: and short strictures have been called *thread* strictures, from appearing as if produced by a thread tied round the canal. The short stricture

is by much of most frequent occurrence, a proof that contraction of the fibres is the most common cause of stricture. Long strictures are probably caused by inflammation attacking a considerable portion of the canal at once, and changing its structure, and this either primarily, or in consequence of thread stricture already existing.

In short stricture, the disease is chiefly, if not entirely, confined to the projecting fold of membrane; but in long strictures occurring in the fore part of the canal the contiguous part of the corpus spongiosum is sometimes likewise affected.

Inflammation, in a greater or less degree, affects the urethra behind all strictures, and sometimes, by throwing out coagulable lymph, which consolidates, lengthens the stricture; and sometimes, by ulcerating, begins a new passage for the urine by the perinæum.

A rare obstruction in the urethra is a band extending across it like a bow-string, produced probably by coagulable lymph, secreted and organized.

The constricted portions are usually harder than the rest of the canal, and of a white appearance. This hardness increases with their age, occasionally even to a cartilaginous consistence.

The common seat of strictures of the urethra is

about the bulb, and especially where the bulbous and membranous portions join, which, as we saw above, is the narrowest part of the whole canal, and about seven inches from the orifice. When more strictures than one exist, which in patients who have long had the disease, is generally the case, that which may be accounted the primitive is generally found at the bulb, and the others, nearer the orifice. Besides being more frequent, strictures at the bulb are more obstinate than in other parts of the canal.* These peculiarities are owing, doubt-

[* An extended opportunity of observation has made me doubt the accuracy of this remark. Strictures at the bulb are more irritable than elsewhere, and more apt to be completely closed by spasm; but notwithstanding their depth in the canal, and their being consequently less accessible to mechanical means of cure, I have in general found them more easily removable than strictures in the spongy part, on account of the neighbouring structure in these often participating in the disease. A case of the latter kind under my care was remarkable as well from the slight degree of irritation produced by it as from its obstinacy under treatment. Although the narrowing was considerable, the only thing complained of was, that during the distension of the corpus spongiosum, it caused a complete stoppage of the seminal discharge; and so callous had the diseased structure become, that the strongest application of caustic scarcely produced a sensation in it. It resisted all attempts at cure by dilatation, and was only imperfectly removed by other means. It is proper however to remark, that such a case as the preceding can hardly with justice be termed a case of stricture, or at least be compared with stricture occurring at its usual seat near the bulb,

less, to the greater vascularity of this part of the canal, and to its greater activity, from serving as an intermediate receptacle for the semen, in the act of generation; during this it may be supposed, the muscle surrounding the bulb contracts to eject the semen, while the posterior or narrower part closes to prevent its return towards the bladder.

Where a stricture exists at the bulb, the whole canal becomes irritable, and disposed to the formation of fresh strictures in the anterior part.

These are the principal circumstances regarding the nature of stricture, which the examination of the patient labouring under the disease, and morbid dissection, have brought to light. From our knowledge of them, the proper indications of cure are easily deduced; and that this has been often unsuccessful, is to be ascribed not to the error of the indications, but to the imperfect means by which surgeons have tried to fulfil them.

[The theory of the formation of strictures which has been given in the preceding pages is principally

where the disease is, (except in rare instances,) limited to the urethra itself. It ought to be regarded rather as a complicated affection of which the stricture may be the part the least important, and the most easily removed.]

that proposed by John Hunter, and it is founded on the facts connected with the morbid anatomy of the parts which are described in his work on Strictures, and admirably illustrated by preparations in his Museum at the London College of Surgeons. Hunter may be said to have exhausted this part of the subject; almost everything of importance relating to it, though usefully confirmed by the laborious and accurate observations of subsequent enquirers, was noticed by him; and had the means of cure kept pace with our knowledge of its nature, stricture would not have so long continued an opprobrium of the surgical art.

It has been conjectured that the idea entertained by Hunter of the muscular nature of the membrane of the urethra, arose from his observation of the usual form of stricture—a narrowing or straitening of the canal as if compressed by a packthread; and it is difficult to conceive how inflammation or any other cause but what he supposed, could produce an effect so limited and symmetrical. Those who deny the existence of such contractile fibres attribute the origin of the disease to the effect exclusively of continued inflammation, and there can be little doubt that this also may in itself be the immediate cause of certain strictures. Admit-

ting this to be generally the case, a more important point remains for consideration, which has had material influence on the modes of treatment employed. The urethra when not distended by urine or any foreign body, remains contracted, or with its sides in contact. Should inflammation attack it, its capability of distension by the urine will be lessened for a time; and should its texture be altered by the continuance of this inflammation, its distensibility will be permanently lost. This morbid change, it is evident, may happen without any considerable deposition of new matter having taken place in the part affected; and a means of cure that will distend the canal to its natural calibre, as quickly as can be accomplished without exciting injurious irritation, would, under such circumstances, precisely as if the stricture were a mere contraction from spasm according to Hunter's idea, appear the appropriate treatment. Accordingly, it has been the practice of certain Surgeons, of late years, to distend the contracted part rapidly by a succession of sounds or catheters, and the success of this method of cure, so far at least as regards the principal object, the permanent dilatation of the stricture, confirms the correctness of the above opinions. That this practice has not become

general is owing to the following causes:—In the first place, the means which have been employed for producing such dilatation are very imperfect, and calculated to excite severe and dangerous irritation; and secondly, the advantage of quick dilatation, even though it could be produced without irritation, has not been generally perceived, from the prevalence of an erroneous notion that stricture is not usually a mere contraction from shortened fibres, as Hunter supposed, or a mere loss of distensibility from inflammation, but a narrowing of the canal from a general thickening of its walls or substance, in consequence of the deposition of coagulable lymph; and that in order to widen the canal, it is necessary to effect the absorption of this lymph, which, it is further presumed, can only be done by slow gradual dilatation. Now, although there may be deposition of new matter in permanent stricture, this in general is of small amount, and acts prejudicially, not so much by thickening the sides of the canal, as by gluing its contracted fibres together, whether the contraction proceeds from spasm or loss of distensibility. The same observations apply to strictures produced by cicatrices following wounds or ulcers of the canal. And even in the cases where from long continued irritation, or the use of instruments, much

deposition has taken place, still, contraction of the fibres must have preceded and will coexist with the deposition, and so far the stricture will be remediable by dilatation alone. Nay, Professor Lallemand, of Montpellier, who has had much experience in this practice of quick distension, or "dilatation brusquée," as it has been termed, recommends it for those cases particularly in which much deposition has taken place in the structures under the mucous membrane, from the idea that the stimulus being greater than that from the usual slow dilatation, will more certainly cause its absorption. But granting that no such advantage follows rapid dilatation, and that the organized mass of adventitious matter requires much time for its absorption, still, if the urethra can thus be rendered distensible by the urine, though its sides should remain for a long time enlarged, the more pressing symptoms of the malady will be relieved, and perhaps irremediable injury to the neighbouring parts from the continuance of irritation, be prevented.

Whether the practice of quick dilatation, as effected by M. Lallemand, M. Mayor and others, is preferable to the usual mode of dilatation by the bougie or sound—whether its quickness and more lasting benefit do more than counterbalance the irri-

tation and other dangers immediately occasioned by it, is a question which it would be premature in this place to discuss. It will be shown that the defects of the plan arise from no fault in the principle, but from the imperfect means that have been adopted for carrying it into effect.

Cicatrices and carnosities or caruncles were formerly deemed the common causes of obstruction in the urethra. The former are not unfrequent, and occasionally constitute severe forms of stricture following rupture of the urethra from external injury; the latter occur so very rarely, that the term carnosity was probably not confined by ancient authors to warty excrescences, but employed generically for the different kinds of obstruction, just as we continue to employ the word bougie or candle for every kind of solid wedge employed to dilate the urethra, and occasionally, though improperly, extend the word stricture to obstructions of the urethra caused by the pressure of parts exterior to it, but which do not contract its calibre. We find indeed some confusion in the employment of the terms caruncle and carnosity amongst the older writers of our own country; Sharp, for instance, employs the words as synonymous, whereas Wiseman makes

a marked distinction between them, as in the passage where he states that "the extirpation of caruncles is no easy work, and if there be a carnosity joined with it, the cure is much more difficult."

The numerous epithets applied to stricture, which it has been deemed necessary to explain, are useful as marking compendiously, important varieties in its nature; but when the term stricture is employed without any such qualification, that which has been described as the permanent, confirmed, or organic kind is usually understood. Permanent stricture, however, is generally attended with more or less inflammation, and is also liable to increase, as we have already seen, from spasmodic affection either of the urethra itself, or of the muscles surrounding it; and the disease, as it usually exists, must therefore be regarded as a complication of the three species into which strictures have by several writers been divided, viz. the Permanent, the Spasmodic, and the Inflammatory. Any of these kinds may exist singly, or in combination with one or both of the others; but as the permanent stricture, or that in which alteration of structure has taken place, is the most dangerous and the most difficult of removal, it demands our principal attention.]

CHAPTER III.

OF THE CAUSES OF STRICTURE OF THE URETHRA.

A PERFECT knowledge of all the circumstances which can operate in the production of this disease is of much importance, as a cause little obvious may be neglected, and allowed to recur, or to continue, so as to embarrass, and render inefficacious the plan of cure.

The causes of stricture, as of other diseases, may be distinguished into those which predispose to the disease, and those which excite it. To the former class belong, living in a warm climate, a sedentary life, too frequent or unnaturally protracted sexual intercourse, and certain peculiarities of constitution, having as their common character great irritability. Some of these by long continuance or when in extreme degree will excite the disease without the intervention of any other.

The immediate cause of stricture is irritation of the urethra, produced either directly, or by

sympathy, with some contiguous part under disease.

Gonorrhœa is a cause so much more common than any of the others, that by many it has even been considered as the sole one. The inflammation of gonorrhœa is, in general, confined to near the orifice, but sometimes is translated to the bulb, or prostatic portion, as we observe on examining the bodies of men who have died while labouring under this disease; when these three situations are often found to be red and inflamed, while the other parts of the urethra have their natural appearance. For the reason stated in the preceding chapter, it is at the bulb that the first stricture generally forms.

There are grounds, however, for believing that stricture would be a much less common consequence of gonorrhœa, were the irritation induced by it not exasperated by the employment of improper injections for its cure. Many surgeons have been so impressed with the idea that frequent harm is done in this way, and no good, as to lay it down as a rule, to employ no injection at all, in the inflammatory stage of gonorrhœa. Sir Everard Home has published this as his opinion; I recollect that Mr. Abernethy also inculcated it in his lectures;

and M. Desault, among the French, was of the same mind. Hunter, on the other hand, although he admitted that in certain cases of peculiar irritability it might be improper to interfere, thought that in the greater number, a judicious local treatment moderated the violence, and shortened the duration of the disease. My experience in the management of these disorders inclines me to prefer this latter view of the subject; and certainly by shortening the duration of the disease, the chance is diminished of succeeding gleet or stricture.

Any other cause of irritation acting directly on the canal may produce stricture, as well as gonorrhœa; as external violence to the perinæum, by falls or blows,—pieces of gravel passing through the urethra,—wounds, or the unskilful passing of instruments, &c.

The irritation of neighbouring parts may be communicated to the urethra, as of the bladder, or rectum. The irritation from stone in the bladder very frequently gives rise to spasmodic stricture. Disease of the prostate gland has the same effect. The acrid matter of cantharides absorbed from blistered surfaces, or when the medicine has been exhibited internally, producing its specific irritation on the

urinary system, has also been supposed a cause of stricture. So may some constitutional disorders and morbid states of the primæ viæ.

Spasmodic or inflammatory strictures may yield altogether upon a removal of their causes; and in all cases the removal of any remaining cause is an assistance in the cure.

[Mr. Hunter was of opinion that strictures are never caused by gonorrhœa, and states several reasons for this belief, particularly the very long period that usually elapses between the removal of the one disease and the appearance of the other. It is exceedingly improbable, however, that so violent an irritation should not frequently have such a consequence. But the contrary idea, that gonorrhœa is almost exclusively the cause, though no doubt equally erroneous, is yet so generally entertained, that if the patient has ever had this disease, no matter how distant the period, his present sufferings are almost always attributed to it as the source. The unhappy result of this is, that the patient from associating these

diseases, under the supposition that they are always connected as cause and effect, will sometimes delay seeking that assistance which, if timely administered, would prevent the most serious evils. "The number is very great, (says Sir Charles Bell,) of eminent men, philosophers and men of letters, who without vice or indiscretion have lost the enjoyment of life, or died miserably, by disease of the urinary organs. The effects of sedentary habits, of long voyages, of warm climates, and of accidents, swell the list of those who seek relief from such maladies in a condition the most pitiable." In addition to this it may be mentioned, that the urethra is exposed to more direct causes of irritation than other canals subject to stricture, as the œsophagus and rectum; it has more sympathies with distant parts, as well as a much higher sensibility and disposition to spasmodic affection; its structure and the office it performs are more complicated; and it would consequently, were there no such disease as gonorrhœa in existence, be a much more frequent seat of stricture than the other canals.]

CHAPTER IV.

OF THE SYMPTOMS OF STRICTURE OF THE URETHRA.

The symptoms of stricture may be conveniently arranged under three heads; first, the effects of the mechanical obstruction of the urethra on the passage of the urine and semen; secondly, local irritations in the urethra, and its neighbouring and connected parts; thirdly, some general disorders of the constitution which occasionally accompany it.

The first symptom of stricture is a diminution of the stream of urine; but it is often for a long time unobserved by the patient, until his attention be called to the subject by some other marked symptoms. As the stream goes on diminishing, it acquires also other peculiarities, such as being forked, or divided; issuing of a spiral appearance, &c.; and when the opening at last becomes very narrow, the urine can no longer be voided in a continued stream, but falls from the penis in drops. In these extreme cases, it rarely happens that the bladder is com-

pletely emptied, owing to the long continued and extraordinary exertions required for this purpose, and the pain which accompanies the attempt. The bladder in this way remaining constantly more or less distended, the desire to make water returns very frequently; and constitutes one of the most distressing symptoms in bad cases of stricture.

Stricture, by being farther spasmodically contracted during the venereal act, often prevents altogether the emission of the semen at that time, and thus proves a cause of temporary impotence.

Among the local irritations accompanying stricture, we may first attend to the state of the urethra itself. There is a greater or less degree of pain at the stricture, and pain is also often felt about an inch and a half from the extremity of the penis, where no stricture exists; pain in this situation being a common symptom of irritations deeper seated in the urethra or the bladder, as for instance, in cases of stone.* A gleety discharge usually accom-

* [In applying instruments to strictures situated deep in the perinæum, I have often noticed that the pain caused by it has been referred not to the seat of the disease but to the outer orifice of the canal. There is frequently sympathetic irritation as well as pain in this situation. In one instance the patient mentioned that his attention had been attracted by an inflammatory redness surrounding the orifice long before any other symptom of stricture appeared.]

panies stricture, and often for a long while is supposed to be the only disease present; until by resisting all the common remedies, its real cause is discovered. Where a stricture exists, exposure to cold, or a venereal use of the parts, will often bring on so much irritation and discharge, that in the latter case, gonorrhœa is suspected. Nocturnal emissions very often arise from the irritation of stricture in the canal. The irritation spreading backwards, may induce inflammation of the prostate gland, or of the urethra passing through it, a state similar to that which arises from the translation of the inflammation of gonorrhœa, already mentioned.

But it is in the affections of the urinary bladder that we find the most distressing local symptoms of stricture. Irritation of this viscus, which we have noticed above as an occasional cause of stricture, is also a frequent consequence; and arises either by sympathy with the diseased urethra, or, which is more frequent, by the retention of the acrid urine, and the forcible efforts which the bladder makes to empty itself. The effects of the irritation of the bladder are, frequent and painful calls to make water; sometimes, inflammation of its coats, which may extend even to the peritoneum, and contraction of its

cavity. The urine, when its receptacle is highly irritated, acquires a peculiar smell, and is mixed with a glairy, viscous, and sometimes puriform discharge; which settles at the bottom of the vessel in which the urine has stood, and adheres to it sometimes with considerable force. Occasionally with irritable bladder, the urine dribbles off involuntarily, obliging the patient to keep something attached to the penis for its reception. Even in the cases in which the bladder is completely emptied, a straining, or still farther desire to urine, may continue for several minutes, and to this may be partly imputed the uneasiness of the loins, of which patients at such times complain.

Complete retention of urine, besides more general effects, may either cause the bladder to give way, allowing the escape of the urine; or, from the excessive distension, its muscular coat may be paralyzed, perhaps never afterwards to regain its power of contraction. When the urine escapes from the bladder in such cases, it is by one or more openings formed by ulceration; and where the coats have already been thinned by this, the danger in retention is increased. The fundus, or upper part of the bladder, is not that which usually gives way; and but in that case, the urine does not find its way into the cavity

of the abdomen, which is an accident certainly and speedily mortal.

It would be tedious to enumerate other less important topical irritations from derangement of the urethra, but some more remote effects of great moment have yet to be considered.

It has just been stated, that the bladder becomes contracted by the long continuance of stricture. Sometimes this is merely a temporary unaptness to dilate, produced by the state of irritation present, and then the effect will cease soon after the cause; but at other times it depends upon a changed organization of the bladder, and is then generally a disease for life. Upon inspecting such contracted bladders, the muscular bands of the inside are found enlarged, and the whole substance of the bladder thickened, often to a surprising degree.

The urethra behind the stricture, and the ureters, instead of being contracted like the bladder in such cases, are often exceedingly enlarged, owing, of course, to the difference of texture and action between these and the bladder.

The inflammation of the prostate gland arising from urethral irritation, is occasionally converted into that hard enlargement, called scirrhus, which has hitherto been little under the control of medi-

cine, and has formed an insuperable bar to the comfort of many, during the last years of their lives.

When the inflammation immediately behind a stricture is severe, ulceration is often induced, and the urine escapes through the side of the canal. This ulceration, in obedience to a general law of the economy, takes place towards the external surface, that is, on the under side of the urethra: and unless previous adhesive inflammation has existed in the part to be perforated by the ulceration, the urine on first escaping from the canal will insinuate itself into the loose cellular membrane around, and spread under the skin to a prodigious extent. In this way the urine sometimes swells the scrotum to the size of the head, and penetrating the spongy substance of the penis, causes by its acrimony the most fatal mischief. If the patient survive the immediate effects of this diffusion, within a few days the skin sloughs at different points, and allows the urine, with pieces of gangrenous cellular substance, to escape by the openings.—On other occasions again, a new passage for the urine is formed with less danger and suffering, the parts being prepared for it by previous adhesive inflammation; so that while the ulceration makes its way to the skin, the adhe-

sions of the cellular substance completely prevent the urine from being diffused ; or an abscess may form in the perinæum, and open both into the urethra, and through the skin, thus giving a ready exit to the urine. These new passages, when their sides become of a callous nature, are called *fistulæ in perinæo.* Upon removing the stricture which caused them, they in general heal of their own accord. It has happened in some cases of fistula, that the ulceration which perforated the urethra has also destroyed the stricture, and a complete cure within a short time has been the consequence. Where strictures are not destroyed by such an ulceration, they are often so much shortened or opened by it, as to allow the passing of an instrument, which could not be passed before ; and where it is possible to get a large catheter introduced, to remain in the canal for the purpose of drawing off the urine, the breach of the urethra will speedily close, and a cure be obtained.

Hemorrhoids are a very common effect of the irritation of stricture. Sores on the prepuce resembling chancres, after the unsuccessful trial of every ordinary expedient for their removal, have been known to disappear immediately on the cure of coexisting stricture, and from it they have accordingly

with justice been thought to arise. The same course has sometimes been observed in chronic enlargement of the testicles, and still more frequently in dropsical affections of these or hydroceles.

It is obvious that a facility in discovering, and skill in treating, these symptomatic affections, which so often arise in the progress of stricture, and react to the increase of the original complaint, will form no unimportant auxiliary in its management.

The constant interruption of rest in bad cases of stricture, from the frequent and uncontrollable desire to make water, and the pain experienced during this act, produce a state of disorder, both mental and corporeal, which is scarcely to be equalled in any other complaint. The function of digestion becomes deranged, various nervous affections arise, and delirium of some hours' continuance occasionally illustrates to what extent the mental faculties participate in the general disturbance. A feverish irritability, resembling hectic, will sometimes come on with the evening, and continue during the night, recurring at the same hour for a week or so, and then ceasing for a considerable interval. A violent paroxysm of fever sometimes occurs, so nearly resembling an ague fit, as to be occasionally mistaken for it. The ordinary remedies of agues, however,

are useless here, and a strict comparison of the two diseases will always enable a person of experience to distinguish them ; it does not recur with regular intervals as ague, and often, when the paroxysm is complete, there is no return for several days.* Epilepsy, gout, and erysipelas, may be mentioned among the diseases which stricture occasionally excites.

Strictures are often of slow progress. They may exist for years, with the stream of urine becoming narrower all the while, before the singular appearance of the stream, the frequency of voiding the urine, or the length of time required for its discharge, attract the patient's attention. For the most part, it is not until the obstruction becomes suddenly greater, from exposure to cold, debauch, an excess of some sort, much exercise, retaining the urine after a

* [An embarrassing circumstance in these cases is, that this fever sometimes attacks the patient before there is any prominent affection of the urinary organs. I had occasion once to see a soldier who had been sent to a convalescent hospital for change of air, under the idea of his being affected with obstinate ague. His strength was much reduced, and he had been under a course of the usual remedies in vain. Questioning him respecting the state of his urinary organs, he stated they were perfectly sound with the exception of his frequently requiring to make water. On examination, I discovered a very narrow stricture.]

desire to evacuate it is felt, &c. that the patient applies for assistance. If he should still defer checking its progress, it will advance with a quickened pace; the increase not being regular throughout the different stages, but accelerated as the stricture becomes narrower, from the constantly increasing irritation.

[The symptoms or effects of stricture, immediate and more remote, which have been noticed above, constitute a formidable list of morbid affections, and yet all are not included in it which have been described by writers on the disease. Amongst other omissions, may be mentioned the formation of urinary calculi in consequence of prolonged retention of urine; and herniæ of various kinds, and prolapsus ani, from the straining at evacuation which this retention excites. Nor have the mischievous effects of long-continued irritation of the urethra and bladder on the kidneys been adverted to; though not so obvious as many of the other results of stricture, they are not less common, nor probably less fatal. Where retention of urine has long existed,

the kidneys occasionally participate in the dilatation of the parts behind the stricture, and they are often found disorganized to a great extent. Their important office as excretory glands may, however, be much disturbed with yet little structural change cognizable by the morbid anatomist; and of the numerous constitutional disorders arising *primarily* from stricture, there can be little doubt that many proceed immediately from perverted action in the kidney, although no local sign, as pain or uneasiness in the loins, may direct the practitioner's attention to this prolific, but as yet imperfectly understood source of disease.

Any feeling of surprise that an affection at first sight of so trifling a character, should be the original cause of so numerous and fatal a host of diseases, will cease, when we reflect upon the constant and very protracted irritation which attends it, on the numerous sympathies of the urethra with distant organs, and the important office it has to perform in the generative and urinary systems. Nothing marks the peculiar character of the urethra, as influencing the general system, in a more striking manner than the fainting which is sometimes caused by merely passing a bougie into it, even where there is neither disease present, nor pain produced;

and at other times, the severe paroxysm of fever which follows the same operation. Notwithstanding this continued irritation acting on a part of peculiar sensibility, and the urethra's widely spread circle of sympathies, when a person suffers from one of the remote consequences of stricture, the medical attendant is apt to be so much absorbed with the effect as altogether to overlook the distant cause, or to consider it only as a troublesome mechanical impediment in an excretory duct, unconnected with, or which has had no material influence on, the disease that may prove fatal to his patient. The unconcern with which Surgeons so often speak of the generally incurable nature of stricture, looking upon palliation by the use of the bougie at stated periods during life as the *ne plus ultra* of their art, (to use an expression of Mr. Abernethy's on the subject,) would lead to the conclusion, that this fatal error in the estimation of its importance is by no means unfrequent. The truth is, however, that stricture of the urethra, although like dormant tubercle in a vital organ, it may, when slight and of little sensibility, exist with little inconvenience to the patient, has always the tendency, when subjected to certain influences, to assume a very different character, and to become the enduring source of spreading and even-

tually destructive irritation. That so dangerous a germ of disease should be deemed almost as irremovable as the morbid and fatal deposition with which, from resembling it in one point, we have just compared it, is, considering its perfectly local character, and the ease with which it may be reached by mechanical means of cure, far from being creditable to the present advanced state of Surgery.]

CHAPTER V.

OF THE DIAGNOSIS OF STRICTURE OF THE URETHRA.

As there are several other affections of the urinary organs which are apt to be confounded with permanent stricture, it becomes of importance to point out the circumstances by which they may be distinguished. These affections are principally spasm of the urethra or muscles surrounding it; inflammation of the urethra; gonorrhœa; tumour, inflammation, or abscess, in the neighbouring parts pressing upon the urethra, and swellings of the lacunæ seated in its texture; stone in the urethra; stone in the bladder; and disease of the prostate gland.

A permanent stricture of the urethra is suspected when obstruction to the passage of the urine has existed for a considerable period, of an uniform or increasing degree, and without any evident external cause; and the truth is ascertained by introducing a full-sized bougie into the canal, which, if there be no stricture, may be passed on to the prostate gland;

and if there is, it will mark the situation of the first it meets, and will even show its dimensions, if soft enough to receive an impression.*

The temporary stricture, arising from spasm or inflammation, may be easily distinguished from the other by its sudden origin, and the pain which accompanies it. But although it be of the greatest consequence to distinguish these, when the question is of the propriety of using the caustic or even the common bougie for the cure, yet where the new plan of cure by dilatation, which I have to propose, is adopted, it signifies little to what species of stricture it is applied; for producing little additional irritation, the only difference of its action on the two

* [In coming to this conclusion, however, we must be on our guard and avoid mistaking impediments from the natural form or irregularities of the canal for disease. Repeated instances of this serious mistake have come to my knowledge. It can be avoided by using a particular means of exploration constructed on the principle of the instrument for fluid pressure, and which will be described under the name of the *dilator sound*. The obstacle which spasm or inflammation creates, can often be overcome by slight pressure, and, as will be stated in the next paragraph, may be distinguished from permanent stricture by attention to the history of the case. Enlargement of the prostate gland will also often prevent the passing of an instrument into the bladder, but this is easily discriminated by the situation of the obstacle and other circumstances peculiar to that disease. A knowledge of the age of the patient will in this case assist us in forming a diagnosis.]

kinds will be, that temporary strictures, especially when from spasm, will be readily relieved by it, while such as are of a more permanent or stubborn kind, will require its longer continuance.

As the aggravation of the discharge after sexual intercourse, in some cases of stricture alluded to in the former chapter, so nearly resembles the infectious discharge in gonorrhœa, as on different occasions to have been mistaken for it, the peculiar character of each requires to be carefully noticed in stricture. The increase of the gleety discharge comes on suddenly after the cause, and if left to itself, will, generally, in the space of a week, gradually decline. In gonnorhœa, on the other hand, a few days usually intervene, after exposure to the infection, before the symptoms arise; they then gradually increase to their acme, and only begin to subside so late as ten days from their commencement. In gonorrhœa also, the pain felt while the urine traverses the inflamed surface, is greater than in stricture, and the stream usually enlarges as it flows.

Phlegmons, abscesses, and tumours in the adjoining parts, pressing on the canal, and causing an approximation of its sides, are sufficiently obvious. The only question that can arise in such cases, is, whether the obstruction is to be relieved by dilating

the part concerned, or, by treatment from without, and the decision of this will depend on the nature of the tumour. The inflamed lacuna may also be mentioned here, which is often felt of the size of a pea, in the course of the canal, obstructing the flow of urine, and requiring treatment similar to that of stricture. And so may aneurismal, or varicose swellings which are mentioned by authors as occasionally causes of obstruction, and as being of difficult removal.

A small calculus passing along the urethra, may stick in it, and become a very troublesome species of obstruction. The mischief is increased, when it is stopped by a stricture already existing in the canal; for it may then act as a valve to the opening of this, and entirely prevent the escape of the urine. This accident is to be apprehended when strictures occur in constitutions disposed to the formation of gravel; and it has happened, that a small stone, thus shutting the passage, has not been discovered until after the patient's death, of which it was the cause. Obstructions from calculi in the urethra are discriminated by the preceding symptoms of gravel; by the peculiar sensation from metallic instruments striking them; by the sudden, severe, and continued pain

which they produce; and often, by being obvious to the touch from without.

Stone in the bladder has occasionally, for a while, been mistaken for stricture, from its being forced, at times, against the entrance of the urethra, so as to obstruct the flow of urine, and from the irritation of the bladder which it produces. The circumstances, however, of the stream being generally full and sometimes suddenly stopped; of the patient being able to make water more easily in some positions of the body than in others; of there being no obstruction to the passage of instruments into the bladder; the sensation communicated to the hand of the Surgeon, when the instrument strikes the stone; the peculiar pain and itching at the point of the penis, which always attends the complaint, &c.—are so illustrative of the presence of calculus, as not to leave a shadow of doubt respecting the nature of the disease.

It has been already stated, that strictures are very rarely, if ever, found farther in the urethra than the beginning of its membranous portion; and as the prostate gland, especially in old men, is very liable to disease, when the bougie can pass seven inches and a half, but not into the bladder, the presumption follows, that it is prevented by the swelling of this

gland. To remove doubt in such a case, we have the means of examination of the gland per anum, and of passing a soft plastic bougie to the obstruction, to take an impression of its form. The possibility, in most cases, of introducing an elastic catheter into the bladder over the projecting part, is another diagnostic circumstance.

CHAPTER VI.

OF THE METHODS OF TREATING PERMANENT STRICTURE OF THE URETHRA.

From the local nature of stricture, local remdies are the only kind, in the generality of cases, employed for the cure. It is only where sudden spasm or inflammation, and the consequences of these, arise, that other or more general assistance becomes necessary. The courses of mercury, adopted by the older surgeons, from the supposed venereal nature of the complaint, and some other general remedies, formerly accounted specifics, are now totally discarded from practice.

Of the local remedies of stricture, we shall consider, 1st, Those which do not produce breach of its substance: and 2dly, Those more violent in their nature, which do.

The first class comprehends different means of dilating and pressing upon the strictures, by bougies, sounds, &c. and by the new instrument called the

dilator; with some medicinal applications to the diseased part, to alter its sensibility.

In the second class are comprehended, caustic, by which the diseased part is directly killed and removed; and the different ways of destroying it by rupturing, by causing ulceration, and by cutting.

[A difficulty in classifying the different methods that have been in use for the cure of stricture arises from this circumstance, that the intention with which certain methods have been employed, or the theory of their action, has frequently differed from their real action. Sounds or catheters, for instance, used for the purpose of breaking down or rupturing obstructions, have often in reality only forcibly dilated them, and, on the other hand, they have frequently caused a breach of substance when sudden dilatation was only intended. The old method of curing urethral obstruction by the endeavour to keep an instrument pressing against it, was adopted with the view of causing ulceration in the part, and thus gradually wearing it away; and no doubt this was often the effect of such practice; but it probably

happened, still more frequently, that dilatation merely, or exhaustion of the powers of the spasmodically contracted fibres, was the consequence, and that the practice differed in no essential respect from that which has been employed by many Surgeons in cases of impermeable stricture, without any very precise theory; and which has, of late, been particularly described, under the name of Vital Dilatation, by the celebrated Dupuytren. The same obscurity attends the action of caustic on strictures. When employed to destroy the substance of stricture, it has, there can be no doubt, often proved eminently beneficial by merely producing a salutary change in the vital action of the part. And with respect to the incision of stricture, it can only, in most cases, be reckoned a measure preliminary to the treatment by dilatation.

With this explanation, we may proceed to consider the different plans classed according to their presumed modes of action; but as several of what have been usually considered distinct methods of treatment may be requisite for the cure of an individual case, the separate consideration of these can only be regarded as a convenient mode of arrangement, and by no means as indicating any opposition

between their nature, or incompatibility in their operation.

As dilatation effected by the pressure of instruments is not only the best and most generally applicable remedy, when exclusively employed, but is an important auxiliary in most other modes of treatment, it requires our first consideration.]

Section I.

Of the Cure of Stricture by Dilatation.

Dilatation acts in removing strictures, by stretching the contracted fibres; and if there be newly organized substance, by exciting the absorbents into action, which removes it.

The means hitherto in use for this purpose, has been to pass a smooth, cylindrical, or slightly conical body, of sufficient diameter and consistence, through the stricture; of which description are bougies, sounds, and catheters. The instrument is then allowed to remain for a limited time, distending the stricture, and successively larger ones are substituted, as it widens, till that of the largest size can be introduced.

By using these instruments with force, the stricture may be ruptured, or caused to ulcerate: but it is with a view to their gentler agency, above described, that they are now to be considered.

The Surgeons of the present day, almost with common consent, prefer the treatment of stricture by dilatation, as a general remedy, to all others. But in cases where the stricture is of peculiarly hard texture, or has something else in its character which would render the cure by dilatation inapplicable or tedious, some of the other means of destroying it are preferred.

The first instruments used for dilating strictures, were probes of lead or whalebone, and common wax-tapers. Bougie, the French name of this last, has since been applied to most instruments used with the same view. The lead was unyielding, and apt to break; the whalebone produced much irritation; and the wax-taper was too soft, when heated by the canal, to make any impression on the stricture.

These defects snggested the substitution of the common wax-cloth bougies, which have since been in general use in all countries. In the present improved state of the bougie, it is thus manufactured: — A piece of cloth on which is spread a composition of melted wax, oil, and litharge, is cut into pieces of

the proper dimensions, and these are rolled upon a plain surface, until they become perfectly smooth cylinders, with a rounded or conical end. They are made of about ten inches in length and of various diameters, from the smallest that will pass, to upwards of a third of an inch. Their advantages over the means formerly employed, are their smoothness and flexibility, adapting them for easy introduction, their consistence, and strength.

Very soft bougies are employed in examining the dimensions of stricture, as they easily receive an impression from its anterior surface. They are generally made of white materials; that the impression may be more conspicuous.

Some Surgeons, particularly in France, prefer bougies made of elastic gum, because their consistence is not liable to alteration from the warmth and moisture of the urethra; and their elasticity prevents the permanent bending of their points when it is necessary to use some force in passing them.

Small bougies of catgut are used when the passage is too narrow to admit a cloth bougie of a size that could pass down to it.

Of late years, instead of these more pliable materials, a mixture of the soft metals, forming what has been called the flexible metallic bougie, has been

employed by many Surgeons. When expertly introduced, from their smoothness, hard consistence, and durability, they may certainly be preferable; but where the inexperienced patient himself has to introduce them, the chance of wounding the weak canal is increased in proportion as they are more unyielding than the common cloth bougie. This objection is still more applicable to the iron bougie or sound, at present adopted by some Surgeons.*

The catheter is another instrument used as a means of dilatation. It is a tube of metal, or of web covered with elastic gum, about ten inches in length. When made of unbending materials, a third of its length from the point is generally curved, so as to be part of a circle of six inches diameter—this form best

* [Other substances besides those that have been mentioned above have, at different times, been fabricated into bougies, such as horn, leather, tortoise-shell, and, latest of all, ivory, rendered soft and flexible by steeping it in a diluted acid, and thus extracting its calcareous matter. As the urethra will sometimes bear the contact of one kind of substance more easily than another, it is desirable to have instruments of various materials at hand. Although metallic bougies or sounds cannot, in general, be so safely used as flexible bougies, which adapt themselves to the inequalities of the canal, still, in the hands of skilful operators, they have often an advantage from the power possessed of guiding the point of the instrument; and it is with this view that hollow flexible bougies or catheters are often rendered stiff and unyielding before introducing them, by placing a wire or stilet in their cavity.]

corresponding to the natural curve of the urethra. Towards its rounded point, there are openings, by which the urine enters it to pass from the bladder, and at its outer extremity, there is a ring on each side, or other projection, by which, amongst other uses, the Surgeon may know its situation in the canal, and be able to direct its course with precision. The original intention of the catheter, and that for which it is chiefly used, is to draw off the urine when the bladder cannot relieve itself.

Such are the common means that have been used for the cure of stricture on the principle of dilatation. The new instrument which I have to describe, as its peculiarities of action and construction require minuter detail, will be better understood after explaining the usual manner in which the cure by dilatation is conducted.

It would be convenient, for ascertaining the progress of the cure, as well as for other reasons, to know always, with precision, the diameter of the instrument employed. For this purpose, a scale with increments of a fortieth of an inch may be adopted, and each increment made to designate a size of bougie, to be numbered from 1 to 17 or 18, the largest that has been used, even after breaking

down the orifice of the urethra for its admission.* It is of the more importance to have a fixed scale for determining the sizes of bougies; because, at present, the scales of no two instrument-makers perfectly agree; and this which I have followed, has the advantage of being definite, easily constructed, and the different scales already in use all approximate to it.

The first thing we have to consider, is the manner of introducing instruments into the urethra and bladder. As an example or rule for other instruments, we shall describe here the introduction of the catheter.

The patient may either stand or recline during the operation. The Surgeon having warmed and oiled the instrument, and holding the penis with the left hand just behind the glans, so as not to compress the urethra, which is on its under side, inserts the instrument, with its concavity towards the patient's belly, and as it passes onwards in the canal, requiring little more force to move it than its own weight, with its straight part remaining almost parallel to the patient's body, the penis is at the same time drawn upwards upon it. On its reaching

the bulb, the penis is again allowed to shrink, and the outer end of the catheter is depressed so that the curved part may rise along the back part of the urethra, behind the pubis. Its entrance into the bladder is announced by the flow of urine, and the greater facility with which it then moves, as well as by the length of it which has passed.

Some prefer introducing the catheter as far as the bulb, with its convexity upwards, and the straight part consequently down and parallel to the thighs; then by a semicircular sweep of this, they bring the instrument round to the situation described in the last paragraph, and the operation is finished as there stated. Unless the patient's corpulency prevent the adoption of the first and more simple method, there can be nothing gained by the employment of the other; on the contrary, as it is a nice matter to keep the point of the catheter in the same situation during the turning, in the hands of many this mode is productive of more pain.

The passage of instruments through the healthy urethra may be variously impeded. If not flexible, they may be stopped by the os pubis when the handle is depressed too soon; or if their curvature does not correspond with that of the urethra, they

may be impeded from this circumstance. It is evident how these occurrences are to be avoided.

If an instrument has a small point, it may enter and be arrested by one of the lacunæ in the fore part of the canal. When this happens the instrument must be withdrawn a little, and passed again with its point bearing against a different side of the passage.

Irritation from the presence of an instrument in the urethra may induce spasm of some of its fibres, which either by grasping it, or closing the canal before the point, may prevent its farther progress. This obstacle is so apt to occur in some particularly irritable constitutions, that it may be proper to give an opiate to obviate or relieve it; but a gentle and continued pressure of the instrument against the obstruction, rubbing the perinæum, or suddenly applying cold water to the parts, will in general, either separately or conjointly, be sufficient to remove the difficulty.

The progress of an instrument may again be prevented, by its point pushing the lax membrane of the urethra into a fold before it. By gently drawing forward the penis on the instrument until it has turned under the pubis, the Surgeon will greatly di-

minish the chance of this inconvenience. Something of the same kind frequently happens when the instrument is entering the narrow membranous part of the urethra from the widening of the bulb. As a general rule in such cases, the point, which cannot be previously bent upwards as is usual in the case of a flexible instrument, must be made to bear lightly against the upper side, while attention is had to keep it in the natural direction of the urethra; and if this be insufficient, assistance must be given in directing the point by the finger on the perinæum or passed per anum; or success will sometimes attend the trial with an instrument of different curvature or size—means especially necessary where enlargement of the prostate is the cause of the obstruction.

When the catheter is not carried forward in the natural direction of the canal, on arriving at the prostate gland, it may be stopped by coming against the edge of it. An inattentive Surgeon may himself produce this difficulty, while attempting to overcome the last one mentioned, by passing the finger per anum so high, as to displace the gland, and change the direction of the canal enclosed in it.

The catheter of elastic gum, in many instances where a catheter is required, from its pliability and

accommodating nature, causing less pain and trouble in the introduction, is to be preferred to that which is metallic and inflexible, and it will often pass in cases of obstruction, where no dexterity can get a rigid catheter through. The wire which lies in it for the purpose of giving the proper degree of stiffness and curvature, may be withdrawn about an inch, and the point being then easily flexible, will often surmount the difficulty with little force applied. From a consideration of the weakness of the membrane of the urethra, the maxim is correctly deduced, that no very forcible attempt should ever be made to overcome any difficulty or obstruction; and the degree of force which is sometimes allowable and proper where a dexterous and well-informed Surgeon operates, would often, under contrary circumstances, be highly detrimental.

There is scarcely another operation in the whole province of surgery, on which the preservation of life may more immediately depend, than on the speedy introduction of the catheter. Bursting of the bladder or urethra, extensive inflammation, and other disasters already described, result from retention of urine unrelieved. And although an observance of the established rules, which I have just given, for conducting the operation, and surmount-

ing the several difficulties, will be sufficient in most cases to effect the desirable end, yet as there are some in which all these are insufficient, I have much satisfaction in describing the following new means, which is frequently of great assistance to the others, and sometimes will secure the introduction, where without it, these would entirely fail. Its simplicity is a recommendation. It is to distend the urethra during the operation with a liquid, injected through the catheter from a bag attached to its outer extremity. It is necessary that during the operation, the penis be gently grasped, so as to prevent the return of the liquid by the sides of the instrument, and the stricture or action of the bladder opposing its flow backwards, the whole urethra is distended with moderate force, while the catheter may still be freely advanced or withdrawn. This distension of the canal removes every obstacle to the passing of the catheter, until it reaches the stricture itself, (an object of considerable importance where it is necessary to pass an instrument in an irritable urethra,) and the orifice of the stricture, being also filled and distended by this unirritating fluid, is open for the reception of the instrument's point. In this way the urethra before the stricture becomes a distended bag, through which calculi or

other foreign substances retained in the canal might also be more easily extracted.

There is no additional rule for the introduction of the bougie to those already given for the introduction of the catheter. In consequence of its flexibility and softer texture, it is less likely to do harm in the hands of an unskilful operator; but still if of hard consistence, it must, by warming it before introduction, receive pretty exactly the curvature of the canal, and its passage must be humoured by the depression of the hand, as in the case of the catheter.

Having now seen generally how instruments are to be introduced, we proceed to describe the manner of examining and treating stricture.

The sure diagnostic circumstance of stricture, it has been before remarked, is the impediment which it offers to the passage of instruments to the bladder. The examination is usually made by a wax cloth bougie. One exactly cylindrical, and of rather large size, should be chosen, because it is not liable to be caught in the lacunæ or wrinkles, like a smaller one, and because it will give intimation of commencing strictures, which being as yet wide, might be otherwise missed.

By continuing, for a little while, to press the bougie against the obstruction, at the same time

that we become certain of its permanent nature, we are also enabled to judge, by the impression received on its point, of the size and form of the aperture : which is the next circumstance requiring the attention of the Surgeon in undertaking the cure by the bougie.

To take an impression from the surface of a stricture on the extremity of a hard bougie, considerable pressure must be used, and this, in many cases, gives excessive pain; very soft, white bougies, as already described, have therefore been substituted ; but in these, the impression is often injured during their extraction. To avoid this source of error, I have protected such a bougie by passing it through a canula.* There are other means of ascertaining

* Plate I. Fig. 2. ["M. Ducamp prend, avec un instrument de son invention qu'il nomme *sonde exploratrice*, l'empreinte du rétrécissement." * * * "De la sorte on voit aussi bien ce qui se passe sur le rétrécissement dans la profondeur du canal, que si l'on avait ce rétrécissement sous les yeux ; et si, comme l'a dit Hippocrate, *pouvoir explorer est une grande partie de l'art*, il faut en convenir, l'art, dans le cas dont nous nous occupons, a fait un grand pas."—Rapport fait a l'Institut de France par MM. Deschamps et Percy.

M. Ducamp, in introducing amongst his countrymen the practice I had recommended, of taking a more exact impression of the anterior surface of strictures than had been in use, omitted, as I likewise had done, to give a caution against being deceived by the marks occasionally made on the soft material by the natural irregularity of the canal. Disappointment has occasionally pro-

the size of the opening of stricture. As by knowing how the water is voided from the urethra, whether in a large or small stream, or only in drops; though this is a circumstance which cannot be always depended upon, as illustrative of the point in question, from the spasmodic increase of contraction, which most strictures undergo on the contact of the urine. Or, the same end is effected by successive trials of differently sized cylindrical bougies, till that which just fills the stricture is found. This is a very common method, but tedious and painful. A better is to introduce a conical bougie or sound through the stricture until arrested; the part of the cone then embraced by the stricture, is its diameter, and this part is known, by comparing the distance of the stricture from the orifice of the urethra with

ceeded from inadvertence to this, and it may lead to errors in practice. If the examination be carefully conducted, it will afford valuable assistance towards a perfect knowledge of the disease, and very much facilitate the proper application of remedies.

In making a bougie for this purpose, the original plan should be adopted, of giving the waxy composition a due tenacity by an admixture of tough fibres, instead of spreading it on a web.

M. Ducamp did not use a canula as a protection to the soft bougie; the only difference being, that without one, it is necessary to use a bougie of harder material, and consequently more painful in its application. I have placed one of his figures of impressions from stricture, beside that illustrating the plan I have proposed. Plate I. Fig. 3.]

the length of the conical bougie which has passed. For the purpose of ascertaining the size of the opening of the stricture, and the appearance of its anterior surface, (circumstances, a knowledge of which is almost equally desirable, whatever method of cure we adopt,) I usually combine the employment of this last means with that of the soft bougie already described. The manner of farther examining the urethra, preparatory to some of the other modes of cure, will be more properly described afterwards.

Having ascertained the existence and situation of the first stricture, and the size of its opening, the Surgeon proceeds to pass a bougie through it, to dilate it. In the beginning of the treatment of a narrow stricture, this is often attended with considerable difficulty and embarrassment. A small, soft, wax-cloth bougie, on reaching the stricture, unless it immediately enter the opening, is apt to have its point bent and turned back on itself, while the Surgeon may suppose he has penetrated the stricture; and the bougie being again straightened on withdrawing it, he may continue in his error, and subsequently persist in useless applications of the same sort. But this mistake may in general be avoided by attention to this circumstance, that the bougie when bending and not entering the stricture

generally recoils a little, on the Surgeon ceasing to press it forward. The body of the bougie bending, however, after the point has passed the stricture, may also, give occasion to this, so that the sure sign of its having passed, is its becoming wedged in the stricture, or grasped by it, and when an indentation or chafing is discovered upon its being withdrawn. The difficulty of introducing small bougies is very much increased, when the opening of the stricture is not in the centre of the canal. If we know on which side the opening lies, we shall more readily hit it, by bending the point of the bougie a little in the necessary direction, previous to passing it; or not knowing the direction, by turning the bougie with a bent point round as a gimlet between the fingers, the orifice may still be found.

The introduction of instruments through a narrow stricture is allowed to be a very nice and difficult part of the treatment, and a point on which the safety of the patient may immediately depend. As a bougie of wax cloth, of the small size that will pass through the stricture has not strength sufficient to retain its form while passing down the urethra; as much danger of piercing the urethra attends the use of a sharp pointed metallic instrument in such a case; and as the catgut, which has been com-

monly substituted for these, on account of its having greater strength with less bulk than any other substance, here applicable, is liable, if retained, to swell from the moisture of the canal, so as to become of difficult extraction, and, consequently, to produce inflammation which may entirely close the remaining opening; I have for some time made use of the following expedient:—I pass a full sized canula down to the stricture, ascertain the situation of the opening, as explained at page 71, and then introduce through the canula the smallest wax-cloth bougie. This being unimpeded by the contact of the urethra, searches for the opening with great advantage; and if the first one fail, others may be successively used, without exciting new irritation. This method possesses some of the advantages of that already explained, for the introduction of the catheter where the urethra is distended with water.*

* ["M. Ducamp se sert, pour introduire les bougies dans les cas difficiles, d'un instrument qu'il nomme *conducteur;* c'est une sonde de gomme elastique percée des deux bouts, et qui, comme tous les instrumens dont il fait usage, porte une échelle de proportion qui lui indique de combien l'instrument a pénétré; il introduit cet instrument jusque sur l'obstacle, et quand l'ouverture de ce dernier est au centre, elle se trouve en rapport avec celle du conducteur. Quand elle est en haut, en bas, ou sur le côte, il se sert d'un autre conducteur muni d'une éminence près de son extrémité; cette éminence étant tournée en bas quand l'obstacle

These rules for passing an instrument through a very narrow stricture, are sufficient when the nar-

est en haut, et réciproquement, élève l'ouverture du conducteur, et la met en rapport avec celle de l'obstacle, de telle manière qu'une bougie introduite dans le conducteur, passe dans l'ouverture de l'obstacle dès qu'elle franchit celle du conducteur ; de la sorte, notre auteur dirige à volonté la pointe de la bougie en haut, en bas, sur les côtes, ou au centre de l'obstacle ; et l'on conçoit sans peine que l'introduction des bougies devient très facile par ce procédé."—Rapport à l'Institut par MM. Deschamps et Percy.

The object of using canulæ with protuberances on their ends, which must render it difficult to pass them, is more easily and perfectly attained by employing a bougie with a bent point, and turning this in the direction of the opening of the stricture: should this fail, or elastic bougies be employed, the following means may be resorted to :—A succession of small bougies may be employed, but without withdrawing from the tube those that have been tried unsuccessfully. In this way the whole face of the stricture is at length covered by a number of bougie points, and the attempt to pass them through may be repeated, without danger of irritation, by gently pressing them, one after the other. This method, which was described as my practice in cases of difficulty, in a publication of the year 1827, has been subsequently proposed by M. Beniqué of Paris. Professor Gerdy, in his work on bandages, recommends, with the same view, to fill up the conducting tube by other canulæ. He expresses his opinion of the importance of these combined means of accurate examination and guidance of the bougie, by terming them "Catheterisme eclairée," in distinction to the former unassisted method of introducing instruments, which he denominates "Catheterisme à tatons."

It is of great importance that the urethra should be thoroughly examined at the earliest opportunity, as we may thus be guided to the proper plan of treatment, and be better prepared for the relief of complete retention of urine, or other accidents that may occur during the prosecution of it. How we are to ascertain the number of strictures existing, and the extent of the canal occupied

rowness is permanent, or not dependent upon temporary spasm; in this latter case, other means, to be considered below, must be added.

A cause of difficulty in introducing instruments, not mentioned above, which Mr. Hunter has described, is where the narrow canal, in cases of long stricture, has a tortuous course.

It is likewise necessary for the Surgeon to recollect, that difficulty in passing a bougie may arise from its entering a false passage, formed by the previous unskilful use of instruments. He should, therefore, in such cases, carefully ascertain whether the patient has been under treatment before; and if so, whether the instrument made progress in the canal without relieving the obstruction: a method of discovering the exact state of the parts will be pointed out in the section on false passage.*

There is a diversity of opinion as to the time that

by each, will be explained in a subsequent part of the work, after the principle has been described on which an instrument for the purpose may be constructed.]

* [As there is much connection between the subject of introducing instruments through cases of narrow stricture, or those which cannot be overcome by common means, and are thence called *impermeable*, and that of relieving the bladder in cases of retention of urine from stricture, the reader is referred to the following Section, in which the latter subject is treated of, and where expedients which may be adopted with equal advantage under both of these conditions are described.]

a bougie should remain in the urethra, some thinking, that unless it be left for hours in the stricture, little benefit need be expected from it; while others assert that every advantage from its use may be obtained by its being there during two or three minutes. The weight of authority, however, is on the side of the first opinion; and although I have found that momentary action of the bougie has occasionally much relieved the symptoms, the cure has always been more rapid when the dilatation was longer continued. The circumstances of the patient, as they render it convenient to him or otherwise to retain the bougie in the canal for a length of time, must often determine the practice. It is a rule in using the bougie, never to produce great pain either by the length of time during which it lies in the canal, or by the size being greater than the stricture will readily admit, as inflammation might be the consequence, and would retard the cure, more than the violent or prolonged dilatation would advance it. This rule does not apply where the instrument is withdrawn only for the purpose of being cleaned, or immediately replaced by a larger, (as in the plan of cure by catheters, almost universal in France); because the presence of an instrument prevents the closure of the canal, which irrita-

tion favours. The pain produced by the latter method of cure is often almost insupportable, and that the patient may tolerate the continuance of the instrument in the passage, it often becomes necessary to give him large doses of opium. The disorder, however, of the general health, proceeding from these causes, and the obligation of remaining in bed during the whole of the cure, are strong objections to the practice.

Where the cure is attempted by repeated introductions of the bougie, the intervals may be from half a day to three days, according to the degree of irritation produced: the size of the instrument being increased as the stricture widens, until the urine pass in a full stream. Severe pain and faintness are occasionally induced by the first passing of an instrument into the urethra, but in general every subsequent operation causes less uneasiness, as the urethra becomes habituated to the sensation, till at length the patient may readily use it himself. Not unfrequently, however, the bougie produces so much irritation, that the Surgeon is obliged to interrupt its use completely for a time, and to have recourse to remedies against spasm and inflammation.*—The

* [In an extreme case of this description which was under my treatment many years ago, a period of several weeks elapsed before

time required for the cure by the bougie will vary according to the nature of the stricture, and the constitution of the patient: and although relief may now and then be so speedy as to excite surprise, more frequently unremitting perseverance for months is required, to produce considerable amendment of the symptoms.

When a large bougie can pass, the rule is, that it must still be used occasionally for several weeks, to prevent relapse; a practice, which, at longer intervals, is generally required during the life of the patient.

Amongst other points deserving attention in the use of the bougie, the possibility of its slipping into the bladder may be mentioned. This may be prevented by tying a tape or thread round its extremity,

the patient could admit the passage of a bougie even as far as the stricture. He had made several attempts to remove the disease before, but on each occasion had soon desisted, on account of the severe pain and irritation produced. A profuse discharge was one of the most distressing symptoms, and the urethra was evidently throughout in a state of inflammation. By a combination of the remedies mentioned in the Section on removing the irritability of stricture, the condition of the canal was sufficiently improved to permit the application of caustic, which rapidly enlarged the constricted part, without increasing the irritation. The patient was a military man, and his duties as a staff officer required that he should be frequently on horseback; to which circumstance, and to his residence at the time in India, I attributed the violence and peculiarity of the disease.]

and to the penis, or by bending down the end of it. —Some Surgeons think it advisable in the cure of strictures, to pass the bougie completely into the bladder, alleging that it then lies with more ease to the patient, than when its point is but an inch or two beyond the stricture. I conceive this to be true only when the instrument is unbending, and has not previously received the curvature of the urethra; when it reaches but a little beyond the stricture, the irritation of the sensible posterior part of the canal is prevented.

[Dilatation of stricture by the use of bougies, catheters, and sounds, is effected in so many ways by different Surgeons, and, occasionally, by the same Surgeon in different cases of stricture, that it may afford a clearer view of the subject to divide these into distinct methods according to the time occupied in the process, and the circumstance of the operation being interrupted or continued. We have already considered, with sufficient minuteness, the slow interrupted dilatation, which is that almost universally adopted in this country. The slow continued dilatation, which

has likewise been noticed, is still common in France ; and in this country it is preferred in cases of peculiar obstinacy, or where there is unusual difficulty in passing instruments. Quick dilatation remains to be considered : it may be accomplished either by the intermitting or the continued use of instruments. By the former method, it has been occasionally practised in England for many years past, and was indeed the common practice when "carnosities" were supposed to be the common cause of obstruction, it being deemed the most effectual method of removing them to break them down ; but it is only in France that quick dilatation has, of late, been systematically adopted. This practice, which must be distinguished from the older French proceeding of forcing a conical catheter through a stricture in cases of retention of urine, by the circumstance of its being adopted where there is no such pressing necessity, does not appear to have obtained the sanction of any practitioner of note in France, until M. Mayor of Lausanne astonished the medical public in that country, by declaring that his experience had confirmed the soundness of the proposition, that the narrower the stricture, the larger should be the instrument employed to dilate it. His whole apparatus consists of a few large cylindrical catheters ;

he presses one of these against the stricture, which he asserts soon gives way, and immediately afterwards he extracts the instrument; substituting a larger one for the next operation. Surprisingly quick cures, it is said, have followed this practice in some instances, but in others, instead of benefit, dangerous irritation, and profuse hæmorrhage, have been the result. The success or mischievous effect of this plan must, it is obvious, very much depend on the length and hardness of the stricture. The full extent to which, as I conceive, this mode of dilatation by a large instrument bearing against the face of the stricture can be carried, will be explained in the next Section of this Chapter on the subject of retention of urine; and had M. Mayor so limited his practice, the extraordinary zeal which he has manifested, by his numerous ingenious writings and his operations at the Hospitals of Paris, in awakening the attention of Surgeons to the very defective state of this department of surgery, would have more certainly attained its object.

M. Lallemand, Professor of Clinical Surgery in the University of Montpellier, adopts the practice of quick dilatation in those cases particularly where there is a thickening of the submucous tissues. He employs for this purpose a rapid succession of conical catheters of increasing size, endeavouring to

open the urethra to the size of the largest in a few days, and being guided with respect to the time of changing the catheters, by ascertaining when they become loose in the passage.

The modification of quick dilatation just mentioned, has, likewise, a distinguished advocate in M. Velpeau, Professor of Clinical Surgery at Paris; who, although he condemns M. Mayor's peculiar mode as being extremely hazardous, is of opinion that there is often an advantage in completing the dilatation in a few days. He prefers, I believe, the intermitting use of instruments to retaining the catheter in the canal.

Other French Surgeons have proceeded in the same track, but with still greater boldness, endeavouring to accomplish their object at one "séance," by passing a succession of conical bougies through the stricture without stoppage or interval.

That there is more or less hazard from whichsoever of these plans of quick dilatation may be adopted, in consequence of the irritation produced, and other effects to be afterwards noticed, cannot be concealed from the eminent Surgeons who have approved of them as substitutes for the usual method of making dilatation by the bougie: but they had only a choice of evils; and considering the slow and only palliative

treatment by sounds and bougies as usually employed, and the many mischievous results of long continued irritation in the canal, any means that holds out a well founded prospect of speedy and complete delivery from the disease, or at least of more durable relief than can be obtained by these milder measures, even though it be accompanied with hazard, will not fail of being frequently preferred.

The light which the success of this plan, in many cases, has thrown on the theory of the formation of stricture, has been noticed in the Chapter on that subject.]

Section II.

Of a new Instrument for Dilatation of Stricture.

We shall now proceed to the consideration of certain defects common to all the instruments which have hitherto been employed for dilating strictures in the urethra, and afterwards enquire whether a more perfect means cannot be devised.

No bougie or sound, it is evident, whose diameter much exceeds that of the opening of the stricture, can be introduced through it. When the largest that can be admitted is used, its effect at first is violent disten-

sion, which, if the instrument can be left in the canal, gradually diminishes by dilatation or absorption taking place; so that, at last, it lies without any distending action. After this, its longer continuance in the passage can be of little avail, but may prove hurtful by the irritation excited. In curing stricture by the bougie, it often happens, from the increased tendency to contract, that, in the intervals between the introductions, whatever is gained by one, is nearly lost before the succeeding; and this interruption of the process of distention, with the irritation produced by the so frequent passing of an instrument, is sufficient to account for the ordinary tediousness of the cure. Indeed, the Surgeon is often obliged to continue his efforts at cure, for a long time, without being enabled to increase at all the size of the instrument; often probably because the bougie, at each time, only overcomes the fresh spasm of the stricture, which the irritation of its introduction has produced, and lies loosely afterwards in the original opening, without the least dilating agency.

Certain practitioners, whose reasonings on the subject probably corresponded with the above, have had recourse to the introduction of substances through the stricture, which, after being passed, gradually swell by the moisture, and thus continue the dilata-

tion longer, and carry it farther, than could be done by the ordinary and unchangeable instruments. Of this nature was the sponge tent, fixed to a thread, and passed into the narrowing through a canula; but the difficulty of extracting it in its swollen state, and other defects, soon obliged Surgeons to relinquish the use of it. Because leather swells by moisture, bougies have been made of it with the same intention, and also of catgut. The objection to all these instrument, is, that their swelling is not under our control, and the extreme pain and irritation caused on withdrawing them, does much more injury than the former peculiarity does good.

The greatest defect of all the methods of dilating stricture now in use is, that, in the majority of cases, they cannot effect a permanent cure. Writers on the subject have attributed this chiefly to the fact, that the obstruction is often supposed to be removed, and the use of the instrument desisted from, when enough of it still remains, considerably to intercept the stream of urine, and thereby to renew the irritation and tendency to contraction. Hence the first part of their rule for obviating the return of the stricture, is not to leave off the use of the bougie until one of a full size can pass easily into the bladder, by which is meant, the largest bougie which the orifice of the

urethra will easily admit. Yet this is very often insufficient, because, as every part of the canal is wider than its orifice, it is evident that no bougie, which the orifice easily admits, can dilate the stricture to the degree required. The other part of the rule for completing the cure of the stricture by the bougie, is to continue its use occasionally afterwards, that the tendency to relapse may be combated and overcome. It is possible that some strictures may be levelled to the surface of the urethra by the usual means, when the orifice of this has been ruptured to admit a large instrument; but, unless the distension of the diseased fibres be carried still farther, any disposition to contract which may exist, will not be destroyed.

As Surgeons, then, have believed that where dilatation could be properly made no stricture would resist it, the great desideratum was an instrument which could be easily passed through the stricture, and any part of which could be then increased in diameter to any size, and with any force, and be again reducible to its primitive small bulk, when the operator should wish to extract it. They seem, however, not to have suspected the possibility of constructing an instrument perfectly answering all these ends, and, up to the present time, nothing

nearer to such has been tried than the catgut and leather bougies, or the sponge, above mentioned. It is my task now, minutely to describe to the profession the instrument invented by Dr. Arnott, as stated in the preface, called the Dilator, which completely supplies the desideratum above mentioned.*

* Great part of this Essay was printed, when I accidentally laid my hand on a book on strictures, by Mr. Luxmoore. I had already seen it among the many works that have appeared on the subject; but to this copy there was attached an appendix, said to contain an account of an improved method of treating strictures, by a new instrument as well as by the catheter. Singularly enough, however, the author has not described the instrument farther than that it operated by a screw; he must either have forgotten to do so, which is scarcely possible, or must have thought that the description might not be satisfactory to the profession. I take notice of it merely because it is likewise mentioned under the name Dilator, a term which is used very appropriately in old surgical writings, to signify any instrument for dilatation, and particularly that which dilated the back part of the urethra in the operation for extracting stone by the "greater apparatus."

[I was afterwards informed that this instrument was made for Mr. Luxmoore by Mr. Weiss of London, and that he had taken the idea of it from a sort of forceps used in veterinary surgery, which he had seen in Mr. Weiss's shop. It consisted of a steel sound, split, as it were, for two inches near its extremity, into several elastic pieces, which could be separated by forcing a ball ended wire between them, and closely resembling, in this contrivance, the instrument recommended of old by Sanctorius for the extraction of calculi. Mr. Luxmoore must have devised this apparatus in, or before, the year 1813, as the appendix to his publication containing an account of it was issued previously to his leaving England, and in the East India Register for that year his name appears in the list of Assistant-Surgeons on the Bengal Establish-

I may mention previously, however, that several less perfect means occurred to him at the same time; such as,—a cylindrical piece of elastic matter (India rubber for instance) introduced into the stricture, and then compressed longitudinally, so as to make it increase in diameter, and open the stricture. Again, a square bit of sheet steel or gold, rolled cylindrically upon itself, as a watch-spring, and resembling, in external appearance, part of a small common pencil-case, with one edge overlapping the other; by two wires affixed near the outer and inner edges of such a spring, it is rolled up closely, so as to make a small cylinder, or unrolled so as to make a large one.—Or, eight or ten wires, of an inch long, applied round a central wire or axis, and fixed to it at one end, as the ribs of an umbrella are fixed to the staff, and at the other end to a ring which slides upon the axis; by pushing this moveable ring towards the fixed one at the end of the axis, the centres of the wires are made to bulge out, and being flat, the whole forms a smooth metallic bulb, varying in size

ment. It would have the same defects, as a dilator in the cure of stricture, as the similar expedients have which will be mentioned immediately; but its history is rather curious, as it was the origin of several other ingenious instruments since made on the same principle, particularly the forceps used by Sir Astley Cooper for the double purpose of dilating the urethra and extracting small calculi from the male bladder.]

according to the approximation of the ends. Or, an instrument, in principle resembling Mr. Hunter's urethra forceps, consisting of several flattened ribs which diverge by elasticity when pushed out of the canula that contains them during introduction ; they may be secured together at the far end, so as also to make a bulb when dilated. The dilatation of this, or the last, may be effected, without elasticity, by a button made to run upon the central wire from end to end, within the bulb ; on coming near one end of which, it would lift the ribs all round from the centre, and thus increase the diameter.

All these, and similar instruments, however, are harder, of less equal surface, and less elastic, than the perfect dilator which I am now to describe ; and this, besides its superiority to all the foregoing in the cure of stricture, is so well adapted for the treatment of various other diseases, that they were merely tried for the sake of experiment.

A dilator proper for the cure of strictures requires, and this one possesses, the following qualities :

1. To be of little bulk and of easy introduction.

2. To be made capable of assuming and retaining any shape and magnitude when in the canal.

3. To be capable of exerting distending force to any degree, and always under control.

A tube of oiled silk, lined with the thin gut of some small animal to make it air-tight, and attached to the extremity of a small canula, by which it is distended with air or water from a bag or syringe at the outer end, with a stop-cock or valve, to keep the air in when received, is a description of the apparatus.*

The thinnest silk ribbon of different breadths, with the edges neatly sewed together, so as to make it tubular, and then varnished with prepared linseed oil, which dries upon it, and leaves the surface perfectly smooth and soft, is what I have found to answer best. The gut of any small animal will form the lining; but that of the cat is preferable on account of its thinness and strength. The canula may be of elastic gum, or of the flexible metal used to make the metallic bougies, or of silver; and the injected air may be retained, either by a stop-cock at the outer extremity of the canula, or by a valve

* [See Plate II. Fig. 1 and 2. In explaining these figures, I shall take the opportunity of inserting several minute particulars respecting the construction of the apparatus and mode of applying it which were published in my second work on the subject in 1821.]

at the silk tube or bag itself. This last method is the only one applicable to the insulated dilator, which is a short length or bulb of the lined silk, to be distended and left in the canal, and having a bit of canula in the centre, for the free passage of the urine; the patient while wearing it being little incommoded by its presence.

The dilator, when empty, is introduced or withdrawn with the greatest ease to the patient.

As the shape of the silk tube is in our power, it may be made so as to have any desired form when distended; and the sizes of dilators may be ascertained with as much precision as of metallic bougies. It has the important property also of being permanent in its dimensions. On one or two occasions, where silk tube of the size wanted was not ready, I substituted sewed bladder; but I found that in the moisture and warmth of the urethra, this yielded in the course of a little time, so as to become of double the original diameter, thus stretching the sound canal on each side of the stricture beyond what it could bear: and in any case where strong pressure were required, such a tube would burst before the effect could be produced.

It possesses strength to bear any degree of pressure which can be useful, for the membrane of the

urethra itself would be torn, before a strong silk tube would give way: it is almost needless to add, that by injecting more air, the pressure in any given case is increased, or that it is diminished by opening the cock or valve.

To those who understand the phenomena of fluid pressure, the precise kind and force of the actions of this dilator are at once intelligible. To those who do not, the following short exposition will be acceptable:—Suppose a vessel filled with any fluid, and having an opening in its circumference; were pressure made upon the fluid at that opening, as by an attempt to force more fluid into the vessel, this pressure would be immediately communicated through the fluid to all parts of the internal surface of the vessel, and quite equally; so that if the hole supposed were of an inch square, and a pressure of ten pounds were made upon it, every square inch of the vessel's surface would immediately be bearing the same degree of pressure. This fact in natural philosophy has often been called the hydrostatic paradox, from the extraordinary results which present themselves from it under certain circumstances. It is familiar to us, for instance, that by one of the patent fluid presses, a pressure of 10,000 pounds may be produced where the acting power is only a

small syringe or pump worked by the hand, and forcing water into a distending recipient. Let us now consider the action of the dilator. If by a syringe having a piston of half an inch square, I fill the membranous tube and condense the air in it with a force of five pounds, every half inch square of the surface of the tube is bearing the same degree of pressure; and, if a stricture should be indenting, or holding in a contracted state, that extent of the surface of the tube, the stricture itself, instead of the tube, is supporting the five pounds of pressure, and of course is dilated by a force of five pounds. We see, then, that the action of the dilator upon a stricture is always proportioned to the extent of the dilator's surface, which is depressed by its bearing against it; and this quantity depends upon three circumstances: 1st. The size of the membranous tube of the dilator. 2d. Narrowness of the stricture. 3d. The resistance to bending, which is offered by the longitudinal fibres of the dilator.

1st. The greater the diameter of the dilator, the greater is its distending force; for the band of the circumference of a large tube contains necessarily more surface than a band of the same breadth of a small one, and the extent of surface acting upon the narrowing is the measure of the force. It is

for this reason that a large dilator requires to be made of stronger materials than a small one.

2nd. If the stricture be wide, it scarcely makes an impression on the dilator tube, and therefore bears little of the pressure; if narrow, on the contrary, it makes a large depression, which extends perhaps half an inch each way from the stricture, and the stricture bears the pressure of all that part of the dilator which is thus narrowed or depressed.

3dly. If by any circumstance the substance of the dilator be rendered difficult to bend in its longitudinal direction, the action on the stricture is much increased thereby; for the stricture, in depressing any part of an unbending longitudinal fibre, must necessarily depress the whole, and would, therefore, have to bear the distending force of the whole surface. Tying the dilator tube upon its canula, so as to be rather tight longitudinally, has this effect in some degree; but if for any purpose we wish much to increase its power, we have means of doing it to any extent, even to rupture or tear the hardest stricture. A few hog's bristles, or thin laminæ of goose quill, interwoven longitudinally in the silk of the bag, will answer in many cases; or the best means of all, is to surround the bag with a cylindrical very thin

gold spring, which contracts upon it when empty, and is opened by it when distended.

In cases of hemorrhage from the nose and rectum, a piece of sheep's or hog's gut, with one end tied, introduced into the part, and then distended with water, has been used to stop the bleeding; and Bromfield dilated the urethra of a young woman, to make passage for a small stone by the same means: but the manner of using the fluid distension in these cases was so imperfect, that it is scarcely noticed in books of surgery, and is unheard of in practice. Some marvellous stories are likewise told of Egyptian Surgeons having inflated the male urethra to such a degree, as to allow of the suction of calculi from the bladder; and it has somewhere been recommended, when stones stick in the urethra, to render their passage easier by distending the canal before them with a piece of gut tied upon the end of a catheter. It may seem somewhat extraordinary that persons who thought of, or tried these contrivances, should not have made the perfect dilator, which is so like them, and which is but a new application of a principle quite familiar to us. We have, however, many examples of a similar kind in the history of the arts: to compare great things with small —the application of steam to move a piston, which

single thought has so much changed the state of society, seems to be that which would most readily strike any man who saw the lid of a vessel of boiling water blown off, or the water projected from its spout, by the force of the steam; yet this application was long unthought of and unknown. Dr. Arnott contrived the dilator several years ago, merely from the consideration of the means most fitted to cure stricture.*

The manner of using the dilator is as follows: Though in general it passes as easily down to the stricture as a small bougie, yet, on some occasions, especially in irritable urethræ, unaccustomed to the presence of instruments, I have preferred introducing it through a smooth canula, in the manner already mentioned. As soon as the bag is sufficiently within the stricture or strictures, (if more than one exist in

* [Besides the above surgical expedients, and others of a similar character which might be adduced, one of the most interesting processes of nature in the animal economy, although it cannot, with propriety, be called a remedial process, furnishes us with a striking resemblance to the new curative means described: I allude to the process of parturition, in which nature herself employs the forcible distension of a membranous bag—or a "fluid dilator"—for opening the passages. Whether the deficiency of this natural expedient, from which much mischief is known to arise, might not, on occasion, be artificially supplied, will be the subject of some observations in the Appendix to this work.]

the canal,) as much air is to be injected into it as the patient can easily bear; and during the time it remains in the urethra, the future admission or escape of the air is regulated by his sensations; that is, if the feeling of distension abate, more may be injected; but if it should increase into pain, a little of the air may be allowed to escape.

Pain should never be given by the distension; for it is wonderful how little force is required to dilate strictures, when it is divested of the irritating, and consequently counteracting quality, that often attends it when produced by the bougie. There are instances of stricture lately recorded by M. Bruninghausen, a German practitioner, which were removed solely by his patients distending their urethræ with urine, by endeavouring to expel it, while they closed the point of the canal. Such distension, however, must have been so very slight, and continued for so short a space of time, that there is reason to suppose that the strictures removed by it were only temporary, or depending on inflammation; nor is the urine, from its acrid nature, well adapted for retention amongst such irritable parts. Instead of using a small bougie, I have sometimes widened narrow strictures sufficiently to admit the proper silk tube dilator by a single or double very small gut, introduced upon

a fine wire, projecting from the canula, distended, and the wire then extracted.

An important advantage peculiar to the dilator, arising when it is not distended too forcibly, is, that it yields for some time to the violent spasm that is occasionally induced by passing any foreign body through a stricture. When a bougie yields, its power of distension is immediately lost; but the force of the dilator is only concentrated, and, returning to the charge, ultimately overcomes every obstruction. Perseverance, in many other instances, is equivalent to strength; the hardest bones will in time give way to the pressure of a soft aneurismal swelling; and for the same reason the firmest stricture soon yields to the gentle but unceasing efforts of a moderately distended dilator.*

* [" Ayant décrit les moyens de détruire avec précision le rétrécissement autant qu'on le juge convenable, notre auteur s'occupe de la seconde partie de l'indication qu'il s'est proposée, savoir: d'obtenir une cicatrice aussi large que le canal dans l'état sain, c'est-à-dire de quatre lignes de diamètre. Il emploie pour cela deux instrumens: il nomme l'un *dilatateur*, et l'autre *bougie à ventre*.

Le dilatateur est un instrument qui porte dans une étendue de quinze à dix-huit lignes une petite poche plus ou moins large: cette poche, étant affaissée, présente peu de volume, et forme, quand elle est distendue, un cylindre de trois, quatre lignes de diamètre et plus. L'idée de ce mode de dilatation n'appartient point à M. Ducamp; il ne se le

To show in a connected manner the superiority, of the dilator over the different kinds of bougies,

dissimule pas: d'autres l'ont conçue avant lui; mais il a le mérite de l'avoir fécondée, et d'avoir mis à exécution ce qui n'existait qu'en projet."—Rapport, &c. par MM. Deschamps et Percy.

In admitting that he had no claim to originality of invention in this instance, M. Ducamp took the opportunity of making a severe attack on the author of this work, as if in anticipation of being himself subjected to a charge of plagiarism, which might thus have the appearance given to it of groundless retaliation. He asserts, or at least contrives that it shall be inferred, that the idea of the dilator had been taken without acknowledgment from the following passage in a Chapter in Desault's works (Vol. III. p. 271,) on the subject of extracting foreign bodies from the urethra. "Les moyens recommendés pour en procurer la sortie sont très nombreux. Quelques auteurs conseillent d'injecter des corps gras dans le canal, afin de le rendre plus glissant; d'autres cherchent à le dilater par des bougies de cordes à boyau. Il en est même qui veulent que l'on introduire dans l'urèthre, à l'aide d'une sonde, un bout de boyau vide et noué par un bout; qu'on le remplisse ensuite d'air, afin de distendre at d'agrandir le canal. Les anciens ont encore recommendé la succion, mais tous ces moyens sont insuffisans lorsque le corps étranger, &c."

After quoting the latter part of this passage, and inserting a circumstance into the quotation not to be found in the original, but which brings the resemblance a little nearer to the dilator, he proceeds to state that I had, "taken up this idea; and without quoting Desault or the proposer of the means in question, had purposed to apply it to the treatment of strictures of the urethra. "I make this remark," he continues in a note, "because Mr. Arnott was aware of

sounds, &c. I shall make the following comparative statement of their respective qualities :—*

the passage just quoted, for he has read the surgical works of Desault and quotes them in his pamphlet published in 1821."

By this imputation another purpose may have been intended. When the discovery should take place that my first publication contained not only a distinct reference to this allusion of Desault, but a clear exposition of the principles of all the curative means of value brought forward by M. Ducamp as his own inventions, (which means were not the subject of my second publication of 1821) he might have hoped that the accusation of my having concealed this allusion would serve as a proof of his ignorance of the contents of that volume. But other evidence will be adduced besides the identity of principle in the several new propositions to be found in M. Ducamp's work and my own, of his being perfectly aware of what my first publication contained.

The reference in question, to the passage in Desault, occurs at page 97, when enumerating the different surgical expedients which, in some respects, resemble the dilator.—" It has been somewhere recommended," I state, " when stones stick in the urethra, to render their passage easier by distending the canal before them with a piece of

* [Instead of the statement contained in my treatise on stricture published in 1819, I shall substitute, with some omissions to prevent repetition, a similar but more minute account of the qualities of the several means which was given in the appendix to that work published in 1821. I shall do so the more readily, because the discussion will tend to elucidate several very important points respecting the action of dilating instruments generally, which were omitted in my first publication.]

The first great defect of the bougie, (which I shall employ as the generic term for all the instruments

gut tied upon the end of a catheter." The reader will perceive, that instead of there being any attempt at concealment here, the reference is a pretty close translation of the relative part of the above quotation from Desault. Far from a desire to conceal any resembling proposition, I was anxious to anticipate a practice, not very unusual on the introduction of any improvement, of mustering up every thing bearing the slightest resemblance that has at any time been proposed, for the purpose of depriving it of its claim to originality. The perfect dilator is, as I have said above, "but a new application of a principle quite familiar to us;" and whatever merit there may be in the improvement which has been effected by its means in the treatment of strictures, can arise only from this application, and from the adaptation of mechanical means to various circumstances of the disease, by which the principle has been rendered so available.

The dilator, like the other new means which I had recommended, was introduced into France in a modified state. M. Ducamp objected to the silk in its membranous tube, and deemed it an improvement to employ a tube consisting entirely of gut; by which modification he not only rendered the instrument useless in most cases of stricture, but showed he was unacquainted with the principle of its construction. He conceived that the purpose of the silk was merely to diminish the diameter of the gut, whereas it was intended to give strength and fixed dimensions to the instrument. Without the silk the gut could not bear the required pressure, and would soon, by swelling beyond its original diameter, act on the urethra on either side as much as on the stricture. What M. Ducamp understood the purpose of, he adopted, and accordingly all such minutiæ as regard the mode of fixing the membranous tube on its

that dilate as wedges,) arises from its requiring to be pushed forward in the canal in order to dilate. The occasional piercing of the urethra, or the tearing of the stricture from its attachments, are consequences of this.

The method of dilating stricture by forcibly thrusting a bougie through it, has always been more or less practised, and it has been preferred to the slower or gradual method chiefly for the following

metallic conductor, of permitting it to vary in length after introduction, &c.—particulars which are essential to its perfect action, and which cost no little trouble in their original contrivance—he has adopted without hesitation, and described with sufficient correctness. The impossibility of preserving a limited distension by the modification of the dilator which he employed, obliged him, in conducting his process of cure, to extract the instrument after a few minutes and substitute the kind of bougie alluded to in the report, which, in distending one part of the urethra more than the rest, was supposed to possess one of the advantages of the perfect dilator.

M. Ducamp's unfortunate misapprehension of the principle on which the dilator is constructed has prevented its adoption in France. The objections which the Surgeons of that country make to it are applicable, not to the instrument which is proposed above, but to M. Ducamp's modification; and they are well founded. Had he understood and described this proposal of an improved means by dilatation, as well as he did the proposed improvements in the application of caustic, I cannot doubt that the dilator would have been as generally adopted as these, from its being applicable to a much greater variety of cases.]

reasons. The relief from it, when it succeeds, is speedy ; whereas the treatment by the latter method requires, in general, a period of two or three months, or even more, according to the obduracy and number of the strictures in the canal : a process so troublesome and tedious, that the patient often losing hope from the slowness of the relief, for a time abandons its further prosecution. The irritation of the stricture, and neighbouring parts, is often greatly increased from the frequent passing of the bougie, and induces, directly or indirectly, some dangerous or obstinate disease in these parts, as retention of urine, its extravasation from breaches in the urethra behind the stricture, inflammation of the prostate gland, &c. And many cases of stricture occur of a texture so firm and hard, from long continuance, or repeated attacks of inflammation, (of which this slow treatment is itself often the occasion,) that gentle dilatation by the bougie may be found inadequate to make an impression on them ; consequently greater force must be applied, or other remedies, as caustic or cutting, must be resorted to.

It may appear at first extraordinary, that any degree of contraction of so small a canal as the urethra, should require so long a period to be dilated, even by the mildest and slowest means of ope-

ration; but several causes conspire to this, of which the following is one of the principal. The stricture is either elastic, or endowed with a power of muscular contractility; if little dilatation be made, this elasticity or contractility will be little, or, perhaps, not at all weakened, and the contraction recurring when the instrument is withdrawn, it may not be till after several such applications that an instrument of larger size can be introduced. The spring has only been bent, or at most its strength has been but slightly subdued. To destroy permanently the power of recontraction, much greater force is requisite. Besides, the stricture, by the forcible use of the bougie, may be slightly ruptured in many cases, as well as dilated, and the ulceration thence ensuing, will still farther tend to make the enlargement of the canal permanent.*

Those Surgeons who prefer the slow and more cautious manner of applying the bougie, which is the common method of using it, are influenced by the

* ["I have been led into the approbation of employing some violence to open the urethra, by the sudden advantages I have reaped from it where I have been necessitated in a dangerous suppression of urine to make way by force into the bladder in order to draw it off and save the patient's life."—Critical Enquiry into the present State of Surgery, By S. SHARP, 1756.

It has been already stated, that a practice founded on the same principles, has of late years been adopted in France.]

great danger there exists of tearing or piercing the urethra, by attempting to force an instrument quickly through a stricture. For this is always of harder and firmer consistence than the adjoining natural urethra in which it is situated, which is indeed a very delicate membranous texture ; and occasionally, instead of being a mere contraction of the canal, as if a bit of packthread tightened it, the stricture occupies perhaps half an inch, or more, of its length. It is evident, then, that if the point of an instrument be lodged within a very hard or long stricture, upon pushing it on with violence, this will probably not be dilated, but be torn from its attachments. Again, of whatever description the stricture may be, if the point of the instrument, instead of being inserted into its orifice, or kept in the line of the canal, should be directed to the angle between its anterior surface and the urethra, upon force being applied, it will certainly rupture this, and be plunged into the neighbouring solid parts. There is great hazard, likewise, of piercing the urethra, from the point of the instrument, after it has passed through the stricture which it is the Surgeon's object to dilate, being opposed farther on in the canal, by being improperly directed, or by another stricture, enlargement of the prostate or of its ducts, pitting, or irregularity of the ure-

thra, &c.; for the Surgeon, in attempting to force a stricture, cannot always discern whether the whole of the opposition felt proceeds exclusively from it, or partly from a further obstruction. It is under these circumstances that the urethra may be pierced, during the gentle use of the bougie, although, from the mischief being then of gradual production, and consequently attended with no alarming circumstance, as hæmorrhage, to excite suspicion, it is not always ascertained during the life of the patient.

These accidents of tearing and piercing the urethra are not of uncommon occurrence; and this not only amongst the Surgeons who advocate the more forcible manner of using the bougie, but amongst those also following the opposite plan, who, betrayed occasionally by their impatience at the little progress they make by milder measures, are led to act in a directly contrary manner to their established opinions. The immediate effect of this sort of injury to the urethra, when occasioned by the forcible thrusting of the bougie, is profuse hæmorrhage, much inflammation about the part, and local and general irritation; and from the insinuation of urine into the breach of the urethra, urinary abscess and fistula in the perinæum may be produced. But one of the most harassing conse-

quences, and which, as has just been explained, may be caused by the gentlest employment of the bougie, is the new or false passage formed by the side of the proper one, into which the instrument almost invariably passes, in any future attempt at introducing it into the bladder; and the original disease being thus left to increase, the patient remains in danger.*

All these hazards are completely removed by using the dilator to open the canal; which, whether it be made to dilate quickly, or more gradually, remains during the process exactly in the same position in the canal, and can only act on the stricture.

With it I possess all the advantages of the quick method of dilating by the bougie, without the danger of rupturing the canal, or the pain and consequent irritation from the friction, and dragging of the stricture that accompany the most successful instances of forcing. — To a certain class of strictures, those, viz. which, from long continuance, or the unprofitable employment of remedies, have become extremely

* Mr. Hunter, in his Treatise on the Venereal Disease, speaks of the practice of "forcing a common sized bougie through a stricture that only allowed a small one to pass," as a hazardous practice which he had "never tried." I was some time ago consulted by an elderly gentleman, into whose rectum a sound had been plunged in an attempt to force a stricture by a Surgeon of eminence, and one of Mr. Hunter's contemporaries.

callous and unyielding, dilatation by the new instrument is almost the only kind applicable; for the mild action of the bougie can scarcely affect them, and the attempt to force such strictures can seldom fail of rupturing the contiguous urethra; while caustic, if applied as it has hitherto been, to the front of the stricture instead of the inside, as I have recommended, will, in many cases, burn a passage through the side of the urethra before it has penetrated the harder stricture.*

* [When the dilator is not distended, it may be of very small bulk, and, of course, there would then be the same danger and impropriety in passing it through a contracted canal with force, as in attempting to thrust a small sound or catheter through a stricture, or in using small instruments with force under any circumstances. This is so obvious that it would have been absurd after the instructions about the passing of small catheters and bougies, to have given any additional caution with respect to the dilator. Notwithstanding this, in a collection of cases of stricture lately published, an instance is brought forward where injury was done by such improper use of the dilator; and as from the manner in which the particulars are related, the inference might be drawn by a hasty reader, that this instrument is not exempt from the objection which we have just been considering as appertaining to sounds and bougies, I think it of importance, with a view of obviating so erroneous an impression, to state the whole of the circumstances. The following is the report of the case:

"*October* 10, 1832.—Captain———, a naval officer aged 60, gives the following history of his case:—He contracted stricture at the age of twenty-five, which embittered the

The second defect of the bougie to be noticed is, that from a progressive motion being necessary to

greatest portion of his life, having brought on, at different periods, incontinence of urine, fistulous openings in the perinæum, and a false passage into the rectum. In the early part of the disease he paid but little attention to it, until incontinence of urine came on, afterwards urinary abscesses, produced by the urethra having ulcerated behind the stricture, and allowing the urine to escape. He then consulted Mr. Whately, from whom he obtained considerable relief. After Mr. Whately's death the stricture returned, and he then placed himself at different times under the care of other Surgeons, but without receiving much benefit from their treatment. He at length in 1824 consulted Dr. James Arnott, who employed the dilator invented by him, from which he obtained considerable relief, being enabled to pass a large sound into the bladder, and making water in a full sized stream. By the aid of passing occasionally bougies which kept the stricture open, he continued pretty well until 1831, when finding that the disease had returned, and that the stricture had nearly closed up again, he attempted to use the dilator himself; in doing so, however, he had the misfortune to burst the urethra, and thus break a passage into the rectum. Considerable hæmorrhage followed the rupture of the canal, which was succeeded by a severe fit of illness." Some few months after his recovery (the report goes on to relate) from the effects of the injury he had inflicted upon himself, he again sought assistance from a Surgeon, but obtaining no relief from him, he applied to the gentleman who reports the case, and who, by an expertly performed operation enabled him, after six weeks, to "go home quite well, making water naturally, and being able to pass a large sized sound into the bladder:" a statement, however, by no means giving assurance that a perfect cure had been performed;

the production of dilatation by it, much needless pain and irritation are produced by the friction of the instrument upon the tender parts as it advances.

on the contrary, as will be subsequently explained, the means adopted in this case, notwithstanding that they may be sometimes commendable as affording speedy relief under peculiar circumstances, and although they may have been employed with great advantage on the present occasion, instead of their being calculated to effect a permanent removal of the disease, are more likely to prove an obstacle to such an end being afterwards accomplished by other measures.

It is only requisite that the Surgeon should read this report with care, and be acquainted with the principles of the practice to which allusion is made, to discern that the accident from the use of the instrument cannot in any degree affect its character of safety. It would surely be unnecessary to insist on so obvious a proposition, that an operation requiring the skill of an expert Surgeon should not be attempted by the patient himself; for it appears by the report that an attempt was made to effect a passage through "a stricture nearly closed up." It would be as reasonable to defend the operation for aneurism from an imputation attempted to be thrown on it, because a patient had done himself mischief by taking the scalpel into his own hands; or the operation of bleeding, because a patient had himself pushed the lancet through the vein into the subjacent artery. The very circumstance of such an endeavour being made by one who had had long and painful experience of almost every other mode of treatment, and who must have been aware with what disadvantage he himself employed the instrument, shows in what value he held that means which had been last applied. Indeed, from my recollection of the case, far from fearing a contrary effect, I would not object, provided all the attending circumstances were stated, to adduce it as

The greater proportion of strictures are very far from being of a callous description; some, indeed,

an illustration of the efficacy of fluid compression in overcoming states of disease which resist every other common mode of treatment. There were, when I first saw the patient, more than one stricture in the urethra, and of so hard or cartilaginous a consistence, and occupying so much extent of the passage, that the ordinary mode of treatment by the sound or caustic could make little or no impression on them; at least this was so tedious and unsatisfactory, that the patient had abandoned its use. Within a fortnight, which I think was the period of my attendance, by the use of a dilator having a distensible tube of sufficient extent to act at once upon the whole of the contracted surface throughout the canal, this was opened to nearly the full size without irritation or other unpleasant symptoms having been produced, and all the immediate distress, proceeding from the disease, was removed. Whether the patient's engagements prevented his remaining longer in town, or any other cause interfered with the farther prosecution of the cure, I do not recollect, but soon afterwards I left England. I had the satisfaction of learning from him, some years after, during my residence abroad, that he continued comparatively well, being able to pass a large bougie; and upon my return on furlough, four years subsequent to the occurrence related in the report, he gave the most convincing proof that he did not attribute the accident to any defect in the means itself, by his anxiety that a dilator might be used in the case of a near relative, who was then labouring under stricture of the rectum.

From the manner in which the circumstance of breaking a passage into the rectum is stated in the above report, it might be supposed that this was the result of one operation. Such an inference could hardly have been intended;

are so morbidly sensible, that the patient can scarcely endure an instrument of any size to pass through

for it is exceedingly improbable that a patient would himself use the force necessary to produce such an effect, and cause the degree of pain that must accompany it. There can be little doubt that the false passage only gradually extended to the rectum, and was the result of many applications of instruments—of the bougie, which it appears the patient had been using, as well as of the dilator. It was, in fact, an illustration of what has been stated of the liability to false passage from the use of instruments which dilate by advancing in the canal, however they may be employed; for when a collapsed dilator is improperly pushed forward in the canal, it acts precisely as a bougie. In the number just published of the Guy's Hospital Reports, (for October 1840,) there are some interesting remarks by Mr. Bransby Cooper upon the danger of false passage from the gentle as well as from the forcible use of the bougie, or sound. He conceives that "false passages are so frequent as to be present in most of those cases where difficulty of passage continues whilst the patient is under treatment; at all events, post mortem examinations of the urethra, in cases of stricture, show that these deviations from its natural course are extremely common." It may even, in some cases, be a fortunate circumstance when the false passage terminates by a rupture into the rectum, as the greater mischief which its further progress might occasion is thus prevented.

In the same publication from which the foregoing case is taken, another is related, where my name is also mentioned without reserve, and which equally requires to be noticed. It is that of a General Officer, who had for a long period laboured under strictures, of which that nearest the

them: and for such the bougie is, from this friction, as imperfect a remedy as for the hard strictures,

orifice was of a peculiarly obstinate nature; and in whose case, it is mentioned, the dilator had been used two years before; but the strictures having returned, he had applied to the reporter of the case, in February 1829.

The natural inference from this statement would be, that the means of cure which I had employed in the case had been of very little avail, or, at least, that this had been of short duration; and that having had nothing else of a remedial nature to substitute, the patient had sought assistance elsewhere. Now, according to my recollection of the case, the patient had received considerable benefit from the means adopted, and would have still farther improved under them, had my attendance been continued. This was abruptly terminated by my departure from England in February 1823, and consequently six years before he applied to the reporter of the case. As to other measures of relief which, if necessary, I might have adopted, it happens that those which were subsequently had recourse to, and as we are assured with considerable advantage, were similar in principle to plans of cure which had been formerly in use, and which I had pointed out in the first edition of this work, as being applicable to peculiarly obstinate cases of the disease.

It was my lot as the proposer of several new modes of practice, adapted to a variety of cases, to be consulted not only by those affected with this very common disease in its ordinary degree, but by a considerable number of persons each of whom had already been under long and varied treatment by a succession of Surgeons, and who laboured under the worst, or at least the most obstinate, forms of stricture. Some of these peculiar cases I certainly failed in curing, but was generally able to afford greater relief than could be had from other existing means; and in a few I was prevented by acciden-

treated of above. From comparing the effects of the bougie and the dilator, in similar cases, I am convinced that, even in strictures of the ordinary degree of sensibility, treated by the bougie, more than half of the pain at the time, and of the consequent irritation, proceed from this friction; which, therefore, not only causes unnecessary suffering to the patient, but protracts the cure, by occasioning inflammation, &c., and consequent intermissions of the treatment. In stating the advantages of quick over slow dilatation, the immediate recontraction of the stricture after the latter on withdrawing the instrument, from the elasticity or muscular contractility not having been much weakened, was mentioned as a cause of the protraction of the cure for months; the effects of the irritation from the friction produced by this instrument, constitute the remaining causes. Although, merely touching the stricture repeatedly with a bougie, will often reduce its sensibility, (and certain Surgeons, who regard the disease as but a permanent spasm of the part kept up by irritation, govern their practice in many cases

tal circumstances, as in the two cases which have just engaged our attention, from bestowing that degree of attention which was required for the cure or more permanent relief of those who sought my assistance.]

by this principle,) any stronger action often produces irritation, which has a directly contrary tendency to the dilatation. Irritation originally induced the disease; and, whatever the nature of the stricture may be, it invariably tends to augment it, so that, in the two or three days which must usually intervene between the several applications, the stricture is occasionally more contracted from the irritation produced than it was enlarged by the instrument. A dilator, even so applied as to produce no more dilatation each time than the bougie, would still, from the distension produced being unattended with friction, remove the stricture perhaps in half the time the bougie requires, and with half the suffering to the patient. Stretching it suddenly, as we have said, destroys its contractility, so that a trifling increase of irritation produces little inconveniency.

Another disadvantage attending this irritation, and which has not been overlooked by Surgeons, is the hardening of the stricture from inflammation, rendering it more difficult to be removed. A stricture being often originally but a spasmodic contraction of the fibres of the canal, or a wrong action of these fibres, is at first easily removeable, and this will often be affected by the continued elastic distension of one application of the dilator, the compressed air

expanding to follow the yielding stricture; but when continued irritation has changed the structure of the part, the cure is more difficult. If you do not make progress *quickly* with a bougie, the following occurs. You harden it, and thus though you may remove the immediate danger from spasm and its tendency to increase, you render it exceedingly difficult or impossible to remove it by other means.

The next defect of the bougie arises from its incapability of being enlarged and diminished while within the urethra; so that, when two or more strictures exist together in the canal, the bougie can seldom act efficiently but on one at a time, which exceedingly protracts the cure; and if a stricture happens to occupy some extent of the canal, unless it be gradually narrower the nearer it approaches the bladder, the pressure made by the bougie must, for a long time at least, be nearly confined to its anterior extremity. Hence it arises that such cases have so often resisted the bougie, while the employment of caustic in them, applied as it has generally been to the anterior surface of the stricture with the purpose of gradually working its way through, has often done great mischief by making a new passage. The dilator supplies the desideratum; but as the long strictures often differ con-

siderably in structure from the short and ordinary species, they require the method of treatment by the dilator to be likewise different.

The common short thread stricture is a mere contraction or approximation of the sides of the canal, or very nearly so, and requires nothing but simple dilatation for its removal. The long ribbon stricture is, probably, often chiefly constituted by a thickening of the coats of the urethra from deposition of new matter, and that it may be removed, it is necessary to get rid of such matter. Pressure causes its absorption ; but pressure, to act quickly and efficiently, ought to be continued. In dilating strictures, Surgeons have never made any difference in treatment between the long and short species, either applying dilatation but for a few minutes at a time, as is the general practice in this country, or keeping the catheter constantly in the urethra, as is customary in France. It is difficult to assign any other reason for this contrary practice of the two contries, than that English Surgeons depend upon simple dilatation as a remedy, while the French have other ends, as ulceration, in view.

Each plan, I conceive, is best adapted to its particular case ; the momentary dilatation, to the short stricture, the continued, generally, to that occupying

some extent of the canal; but as there was, till lately, no perfect means of distinguishing these varieties of stricture in practice, the plan of short dilatation, as being generally the appropriate kind, appears to have been the best, producing equal advantage with the other, without the increased trouble and irritation. In conducting the cure of long strictures from thickening of the urethra, the dilator may be used repeatedly, keeping up a gentle pressure for a considerable time each application; or if the patient's mode of life or circumstances will permit it, the canal may be so distended by one sufficiently continued application of the elastic dilator, as to admit a flexible catheter of the largest size, which will remain in the urethra, to continue the distension till the obstructing matter is absorbed. When such a stricture occurs near the orifice of the urethra, the introduction of the catheter is not requisite, as a very short tube, properly fixed by tapes to the penis, or to a ring which has been passed over it, will preserve the dilatation without incommoding the patient. When the stricture is in this situation, caustic may be easily and correctly applied to its inside or channel, in the manner which I have recommended in my Treatise on Stricture, and will often expedite the cure. The unchangeable dimensions of the bougie must be

reckoned another great objection, as from this proceeds its incapability of completely dilating the stricture, that is, of reducing it to a level, or beyond a level, with the adjoining urethra. The orifice, which, from being surrounded by a firm band, will scarcely admit of dilatation, has been frequently cut to permit the passage of large instruments ; but even then, they can seldom be used of sufficient size, on account of the great irritation excited by their passage down the canal. They have accordingly, in general, been long given up, and most Surgeons have been content merely to palliate symptoms by the employment of such sized bougies as can safely be introduced.* By this means, although the more violent and sudden effects of stricture are prevented, the long continued irritation of the urethra, which is the almost constant attendant of this disease, seldom leaves the general constitution, or the condition of the neighbouring organs, unimpaired. When we find that a very trifling irritation of this canal is sufficient to induce a violent paroxysm of fever, we can easily account for the

* The impropriety of using large instruments, on this account, was shown, fifty years ago, in the writings of Sharp and Bromfield. I had occasion lately to see a patient who had been confined to bed for two or three weeks, in consequence of a violent irritation of the urethra and bladder, occasioned by an attempt to pass a very large sound into the bladder.

emaciation, irritability, and general derangement of the functions in patients who have long complained of stricture. They are constantly liable to sudden retention of urine ; the functions of generation may be deranged ; and the bladder and prostate gland, disease of which so often embitters the latter period of life, seldom escape injury.—If any strictures be found which cannot be permanently removed by the dilator, although it can be introduced through the narrowest orifice, and dilate to any extent, without exciting injurious irritation, yet all at least will be done by it, and that speedily, which dilatation in any way is capable of effecting.

There are other minor advantages possessed by the dilator over the bougie, which it is unnecessary here to enumerate. I shall however consider one of them at present, because it may furnish the Surgeon with a means of relieving some cases of impassable obstruction in the urethra, which formerly could only be removed by measures of considerable hazard. When two or more strictures exist near each other in the canal, it occasionally happens that the openings through them are not in the same line, so that an instrument which has passed through the first, is directed by it away from the opening of the second, and often cannot proceed. Something of the same

kind frequently happens in long strictures which are tortuous, and which indeed can scarcely be distinguished from the other. If an attempt be made to dilate such strictures by pushing the instrument forward, there is great risk of piercing the side of the canal, and if caustic be applied to a long stricture, we have already seen the danger of its deviating from the desired course. The dilator, however, as it can open the first short stricture, or the beginning of a long one, without the possibility of its doing injury further on, easily opens its way through all when it has once entered.

[After the foregoing statement of the many and important points in which the fluid dilator has manifestly the superiority over the bougie and other wedge-like instruments, it may be proper to notice certain defects, which it has been alleged the dilator possesses. It will be unnecessary to occupy the reader's attention by a prolonged consideration of such allegations, because as they have for the most part originated from the parties making them having formed erroneous notions of the construction

of the instrument and of the principle of its action, what has already been stated on these heads is almost sufficient.

We have already mentioned the mistaken notion into which many have been led by M. Ducamp's misconceptions on this subject, viz. that the dilator, by the swelling of its distensible tube from the heat and moisture of the canal, acts as much on the urethra on either side as on the stricture. The dilator which I have described has dimensions as certain and fixed as those of the sound or bougie, and will therefore act only upon what it is intended shall be subjected to its pressure.

It was said, at first, that although it might be well adapted to the early stages of the disease, pressure by a fluid could never be sufficient for a substance of so hard and unyielding a nature as that of which many strictures consist. This objection originated from unacquaintance with the phenomena of fluid pressure. So far from the dilator not having sufficient power, the fact is, that in cases where great distending force is required, this can be applied in much greater degree by an instrument which acts from the centre directly outwards, than would be safe if made by instruments acting from before backwards on the principle of the wedge. The force of

the dilator is only limited by the strength of the material containing the fluid, and as this may be a woven tube of the strongest silk, and otherwise strengthened if necessary, no kind of stricture will be found capable of resisting it.

Another imputed defect of the dilator is, that being of considerable bulk, it cannot be used until the stricture has already been considerably opened. One writer endeavours to make it appear that on this account it would be without utility to substitute it for the bougie, for when the stricture is large enough to admit a middle sized bougie, (and the dilator in his opinion cannot be of less bulk,) "the cure, he says, may be considered as all but accomplished." Yet the same writer admits, in a different part of his work, that other measures are at times required to supply the defects of the bougie; and a few pages after the passage just quoted, he states, that although there may be no recurrence in a few cases of incipient and spasmodic stricture, after the treatment by the bougie, such cases must only be regarded as exceptions to the rule, and "that a patient who is desirous of continuing well must submit to the occasional use of the bougie ever afterwards." Those who have objected to the dilator because of what they erroneously conceive to be its

necessary size, have not probably had any experience in the use of it; nor in the absence of this, do they appear to have reflected, although often obliged for various reasons to desist from the use of the bougie, how essentially different in character the process of dilatation produced by an instrument which acts as it advances, must be from the equable and eccentrical action of fluid compression. To explain how these differ would be to repeat the comparative statement which has just engaged our attention.

Granting that the dilator could only be used in wide strictures, or even after the largest bougie that the urethra will admit, it would still be of the greatest value, as enabling us to distend the seat of obstruction to the full natural extent of the canal, or to any required greater extent, in order to secure a permanent cure; or failing in this, to procure at least a longer cessation from irritation and other morbid action than can be effected by the limited operation of the bougie or sound. When employed at earlier stages, it has all the advantages of safety, expedition, and ease, which have been stated; and it will appear, when the method of constructing the instrument is explained, that a dilator may be made almost of as little bulk as the smallest bougie

that can be used with safety. Besides, even where from narrowness or tortuosity of the stricture the smallest bougies cannot be introduced, we have seen that the dilator affords a valuable resource.

It must be conceded that its essential qualities of pliancy and impermeability to fluids render it difficult to keep such an instrument in perfect condition; and so far, were it compared with simpler means of equal utility, it must be reckoned defective. But admitting that there were even greater difficulties to contend with in the construction of the instrument, and in the manner of using it, than those that have been alleged, and which have excited much prejudice against it, they can form no substantial objection to the adoption of this means, if its use prove more advantageous to the patient than other modes of treatment. This is so evident, that it is extraordinary such an objection should have been expressed by persons who at the same time admitted its superiority. There are many operations in surgery requiring pains and minute observances for their due performance, but no conscientious Surgeon thinks of objecting to them on that account, or of preferring other operations less beneficial to those who have entrusted themselves to his care, because they are less complex or troublesome. It is surely

unnecessary to dwell at greater length on so obvious a truth, that simplicity in a surgical operation, or in the apparatus employed, is only to be commended when it proves of no disadvantage to the patient.*]

Section II.

Of removing the Irritability of Stricture; of Retention of Urine from Stricture, &c.

Caustics, when used so as not to destroy substance, and other means of removing the irritability of stric-

* [A ludicrous example of an attempt at simplifying the apparatus I have described, and of singular misconception respecting its mode of action, came under my notice soon after the publication of this work. A Surgeon of some eminence in London wrote to me requesting I would allow him to have one of my instruments as a model for the construction of a dilator which he intended to use in the hospital with which he was connected. After a little while, I received a note from him intended to accompany my instrument, but instead of the model being returned, his servant had, by mistake, brought me the new instrument. I found to my surprise, that in place of a strong air-tight tube of fixed dimensions and moderate diameter, attached to its conductor in the manner I had advised, so as to facilitate its introduction, he had substituted a bit of scraped pig's gut tied upon the end of a tube, allowing the air to escape at every point, and of a size fitting it for the purposes of the sausage maker. He had in fact anticipated M. Ducamp's improvement, and would, doubtless, had he used such an instrument, perfectly coincided in opinion of its utility with those who have judged of the dilator, not as constructed by my directions, but as it was modified by M. Ducamp.]

tures, must be regarded as only occasional assistants in the prosecution of cure, by more efficacious remedies. They often remove spasm or inflammation from the urethra, but as permanent stricture does not depend on these alone, they, of course, cannot effect the complete removal of such. In some cases, however, they may excite absorption of the diseased parts, and thus produce more permanent good.

Simply touching a stricture with a bougie, as has been already remarked, often diminishes its sensibility, as moderate admission of light gradually removes excessive sensibility from the eye ; but if great stretching is produced by it, much irritation may follow.

Another customary means is to touch the stricture for a moment with lunar caustic, or to allow a small particle of caustic potass to dissolve within the inflamed part, and thus to destroy the sensibility of its surface. This may be carried to the stricture in a hole or depression in the point of a bougie, or other convenient instrument.

I am at a loss whether to speak of medicated bougies (in the particular sense of the term) at one time so generally used, as the most inefficient means of removing irritation, or as really a cause of its increase ; but it is of little consequence, as they are now abandoned by regular practitioners. It may

be a question, however, of more importance, whether the direct and continued application of liquid anodyne medicines, as of opium or belladonna, to the contracted portion, might not diminish its irritability. From the few trials which I have made, I am inclined to think favourably of this means.

When the irritation from bougies, exposure to cold, debauch, &c. has proceeded to such a height as completely to close a stricture, every means that our art can afford is demanded to relieve the consequent retention of urine.

It is chiefly when the irritability is in this degree, that more general remedies become useful. If the retention has not existed long, and the patient does not as yet complain of great uneasiness, general and topical antispasmodic and antiphlogistic measures may be alone sufficient for his relief, and the one or the other of these will be chiefly employed according as the retention is supposed to proceed more from spasm or inflammation. Opium, in some of its forms, taken by the mouth, or injected per anum, the warm bath, warm fomentation, or the application of a bladder containing warm water to the perinæum, or blistering this part, are amongst the best antispasmodics; venesection, topical bleeding by leeches, and the exhibition of cooling purgatives or

clysters, are the antiphlogistic remedies to be employed.

Generally, however, with some of these it becomes necessary, from the suffering of the patient, and the danger of delay, to resort to the introduction of the catheter or bougie; the temporary increase of contraction may in time give way to the other means, and to the force of the accumulating urine, without great mischief ensuing; yet we must by no means, with this expectation, overlook the patient's present misery, and become remiss in our endeavours at more certain relief. The power of contraction in the bladder would in many cases be lost by too long delay; inflammation might be excited, and even spread over the abdomen; and a fatal effusion of the urine from ulceration would at last ensue.

In addition to the rules for passing instruments in cases of difficulty, already given in this Chapter, I have to add the following as particularly applicable to this case. When the bougie cannot be made to pass immediately, by leaving it in the canal, with its end close to the stricture, for a considerable time, and then repeating the attempt, it will often either go through, or the irritability will be so decreased as to allow the escape of the urine. When a very small catheter can be passed in such a case, it is to be pre-

ferred, because by leaving it in the canal, we ensure a ready passage for the urine, till the irritation be removed.

Many opinions have been entertained regarding the manner in which instruments operate to the relief of the patient, by thus lying in the urethra. Sharp supposed that the stricture might be relaxed; either by the instrument's causing a discharge from the canal anterior to it, because, on other occasions, such a discharge frequently relieves the irritation; or, that by exciting the urethra, it causes the bladder to act with force sufficient to overcome the recent increase of contraction. Hunter imagined that the bougie, by acting in another part of the urethra, and causing it to contract, might diminish the irritability of the diseased part; and he remarks, that stimulant injections have a similar beneficial effect. Others have thought that the contact of the bougie with the stricture directly diminishes its irritability; and the advantage occasionally derived from a slight application of caustic in such cases, is an argument in favour of this latter opinion.

Surgeons have hitherto used small instruments in cases of retention from closed stricture, that they might pass through when the spasm yielded: but in pressing against the stricture with a point, unless

it bear upon the orifice, it can have no tendency to open it, and there is danger of piercing the side of the canal.

It seems not to have occurred to them, that a large instrument pressed against the stricture, and not expected to pass through, will still frequently open it more certainly than a small one. We see a hole in an elastic substance greatly stretched, by pressing a ball or rounded end against it; and such is, indeed, often the best and most certain means of opening a narrow stricture. The plan which I have recommended above, of passing a large canula, (which in this case has a rounded end,) enclosing an instrument, down to the stricture, is very applicable here; pushing the canula against the stricture, opens it, while the small bougie, or catheter within is ready to be passed through. By simply pressing a large bougie against a closed stricture the urine will frequently follow.

When these methods to open a stricture prove unsuccessful after a sufficient trial, others of a more violent nature must be had recourse to. Such is forcing the passage by a well directed conical metallic catheter, or even piercing the stricture with a cutting instrument. Puncturing the bladder is our last resource; but fortunately is an expedient, which

the skilful Surgeon has scarcely ever occasion to employ.

It will not be deemed foreign to the subject, just to mention here, the irritation which frequently exists for a long time in the prostatic portion of the urethra, producing strictures, or embarrassing and preventing their cure. The characteristic symptoms are strangury, a burning sensation and faintness experienced on the introduction of the bougie, the point of which is often found, on extraction, to be soiled with a bloody purulent discharge. The best method of removing this irritation, according to Mr. Abernethy, who first particularly described the complaint, is to pass a bougie occasionally over the part; if this prove insufficient, topica bleeding, blistering, and fomentation may be used.

[It will be necessary to make a few observations on each of the subjects adverted to in the three preceding paragraphs, in order to bring the account of them to a level with the existing state of knowledge.

With respect to the plan of opening stricture by the moderate and continued pressure of a large instrument, it may be mentioned, that a fluid dilator

having a short distensible tube of a breadth considerably greater than that of the natural canal, and applied close to the obstructing part, will act very much on the same principle, and will be found a valuable addition to our means of relieving retention of urine, or overcoming strictures otherwise impermeable. This action of the dilator in front of a stricture differs from that adverted to in page 133 : they may, however, take place at the same time, and may both be required for the end in view.

In a preceding section, a means was described of opening the urethra for the passage of the catheter, by injecting it with water. In my second publication on these diseases in 1821, a modification of this plan is mentioned, which I had employed with success in cases of retention, viz. the distension of the urethra by a column of water ; regulating the pressure, of course, by the height of the column. The principle of these practices was soon afterwards adopted by M. Amusat, of Paris; who ascertained that it had been applied by Mr. Trye of Gloucester, about forty years before, and also by M. Sœmmering in Germany. He objects to their plans of operation, without, however, proposing one very superior himself. In order to compress the caoutchouc bag containing the liquid, he recom-

mends the expedient of squeezing it between the knees; which, besides being inconvenient, is objectionable from the difficulty it creates of estimating the force applied. A syringe constructed on the principle of the common double action enema syringe is a convenient mode of imparting the required force to the injection, being connected with the injecting tube by a flexible piece, and having a ring at the end of the piston in order that the Surgeon may inject with one hand, while he closes the urethra with the other. Injection may be combined with the use of the dilator as described above. For this purpose a membranous tube must be tied on a canula which has both its ends open, and through which water or some anodyne solution may be injected. By inflating the short tube of the dilator, the liquid is confined to the face of the stricture, and consequently a greater degree of pressure may be applied than would be justifiable when the whole anterior part of the canal is distended.

In many cases moderate fluid distension will be alone sufficient to remove the obstruction causing retention, and it is always a valuable resource should the administration of powerful narcotics, the warm bath, the abstraction of blood both locally and generally if the habit of the patient permit, and the cautious

and patient use of small flexible instruments fail of success. Force, whether by means of solids or fluids, should, as a general rule, never be resorted to, until all milder measures have failed; and of the local means, the least likely to increase the irritation, should be the first employed.

Our success in forcing a passage with a conical catheter, or by means of a sharp instrument, will depend principally on the length and hardness of the stricture, and its situation in the canal. If it should have been ascertained by any previous examination during the treatment, that a considerrable part of the canal is obstructed, the chance of success is diminished; and in the absence of such previous examination, the length of time the disease has existed, and other particulars of its history, will assist us in forming an opinion of its extent. Whether a sharp or a blunt pointed instrument ought to be preferred is the next consideration. If the Surgeon succeed in applying the point of a conical instrument correctly, or in penetrating a little way within the obstruction, (as mentioned in the subsequent section on rupturing strictures,) there is a great probability that by persevering with patient endea-

vours, while he guides the instrument by a finger in the rectum, he may in time cause the whole length of the stricture to give way without any breach of substance through which the urine might insinuate; but if the point of the instrument cannot be thus applied, and our only alternative were puncture of the distended bladder, I would prefer piercing the stricture, particularly should this have been formerly ascertained to be of short dimensions, and were situated, either in the fore part of the canal, or, if deeper, had the urethra dilated behind it.

The last resource is making a direct opening from the outside into the part in which the urine is retained: the bladder, or the urethra behind the stricture, may be punctured. The latter operation was probably the first practised; it is mentioned by Wiseman, who is silent about the puncture of the bladder; but it appears to have fallen completely into disuse. We owe the revival of this means to Sir Astley Cooper, who was led to it by observing that the urethra of a patient whom he was called upon to relieve, was obviously distended with urine; and under the influence of his high authority, it has frequently been practised during the last twenty years. Sir Benjamin Brodie relates that in a case in which he performed this operation, when the

patient strained to void his urine, the urethra behind the stricture was dilated into a tumour of the size of a small orange. In such circumstances this is undoubtedly the preferable plan, and a great improvement on former practice; but when the patient is already in much danger from irritation, a prolonged and painful operation in a deep perinæum may, even should the immediate object of relieving the bladder be attained, turn the balance against his recovery.

Of the three modes of puncturing the bladder, that by the rectum, and from above the pubis, have generally been preferred. The circumstances accompanying the disease will often determine which of these two plans should be chosen; such, for example, as the existence of contracted bladder, or of enlargement of the prostate gland. The principal objection to puncture above the pubis has been, the frequent fatal effects of extravasation of urine into the cellular membrane surrounding the wound. A mode of preventing this by giving a catheter, constructed for the purpose, the action of a syphon, and by the adoption of sufficient means of retaining the catheter in the bladder, is mentioned in my Essay on urinary calculus, when treating of the high ope-

ration of Lithotomy.* Were the effusion of urine certainly prevented, this mode of puncture would be an operation productive of little hazard compared with that arising from the local and constitutional effects of protracted retention and consequent suppression of urine; and it might be adopted with less hesitation on other occasions of irremediable obstruction in the channel of the urine.

Chronic disease of the prostatic part of the urethra has of late years been made the subject of particular investigation by M. Lallemand, who has published the results in a series of volumes. These consist principally of cases adduced to prove that this affection is the source of the greatest bodily and mental disorder, in consequence of the irritation extending along the seminal ducts, which open on this part of the canal, and thus exciting both excessive secretion of the seminal fluid and its frequent involuntary discharge.

In addition to the causes of this disease already spoken of in page 39, M. Lallemand directs the attention of Surgeons to one which he considers of still

* See Plate II. and Explanation.

more frequent operation, viz. the abuse of the generative organs ; and recommends as the principal remedy, that caustic should be applied to the diseased surface, so as to alter the vital action of the part, and bring it back to its natural and healthy condition. He applies the caustic by an apparatus which will be described presently, and which is also well adapted for the use of this powerful remedy in other affections of the urethra dependent on a state of chronic inflammation. The illustrations of this practice which M. Lallemand's writings contain are striking : numerous cases being given of a complication of symptoms, indicative of the prostration of both mental and bodily energies, subsiding immediately on the patient's recovery from the slight degree of inflammation produced by only one application of the remedy. If the conclusions of this acute observer be confirmed by more extended experience, it will be acknowledged that he has made no little addition to our knowledge of a class of morbid affections, which have not, perhaps, as yet, engaged a share of attention proportionate to their importance.

Amongst other remedies for allaying the irritability of strictures, the removal of its occasional more

remote causes should not be neglected. A morbid or disordered state of the alimentary canal, and of the organs connected with it, has already been mentioned as a cause of spasmodic stricture, and remedies exhibited for the removal of these and other irritations acting sympathetically on the urethra, are often of essential service. Such concomitant affections must be treated on general principles, the consideration of which is not within the scope of this work. But it is proper to observe here, that such morbid conditions of remote organs are also often caused by continued irritation in the urethra, and that they may react very injuriously on the original local disease. As spasmodic strictures can frequently be removed solely by the remedies for these morbid conditions, no local application beyond the use of leeching or fomentation should be made until such remedies have had a full trial; but where these are found inadequate, the morbid irritability of the urethra may be allayed by the occasional presence of a bougie.

Inflammatory strictures, in their acute stage, are to be removed by the use of certain of the general and local means applicable to inflammation, wheresoever it may be situated: the introduction of instruments into the canal must be avoided. In their chronic state, they

admit of relief from gradual distension, which is best applied by means of a fluid dilator; and the cure may, in some cases, be greatly facilitated by such an application of caustic as will modify the action of the diseased surface.

The several general and local remedies which have been alluded to, are equally beneficial in removing the inflammatory and spasmodic affections occasionally attendant on permanent stricture; and may sometimes be employed with advantage in obviating the irritation likely to follow the measures deemed indispensable in its cure.]

Section IV.

Of the Destruction of Stricture by Caustic.

The term caustic is given to all those substances which possess the power of destroying any part of the texture of the body to which they are directly applied. Many kinds of caustic were used to destroy strictures before the last century, with variety of result, according to the kind used, the manner of applying it, and the state of the disease; but generally with so much pain, and other mischief, as to have caused the practice to be long forsaken. About

fifty years ago Mr. Hunter revived this method of treatment, having ascertained, from morbid dissection, that strictures are in general but simple projections inwards, or folds of the membrane of the urethra, and consequently so short as to be easily destroyed by caustic. He devised a more perfect manner of applying it than had been before practised, and used it with great success in cases where, from the smallness of the opening, or other causes, the common bougie was inapplicable. His successor, Sir Everard Home, convinced of the insufficiency of the bougie alone to effect a permanent cure, in almost any case, extended the application of caustic to all. This indiscriminate extension, from the mischievous effects that followed it, when adopted by less able practitioners, and sometimes even in the hands of the most dexterous, owing to the still imperfect mode of application, has brought upon the caustic unmerited obloquy, and it is now again little used.

Modern Surgeons have made use of two kinds of caustic—the argentum nitratum, or lunar caustic, and the potassa, or caustic vegetable alkali. The lunar caustic is preferred to the potass, being more manageable from its hardness, and because, from its slow solution, its action is confined, in a great mea-

sure, to the part touched. On the other hand, the solubility of the potass is by some deemed an advantage, where it is the intention only to deaden the sensibility of the inflamed urethra, as the small particle used soon becomes liquid, and mixing with the secretions of the canal, spreads over the surface; but its employment in great quantity is inadmissible, because, from this spreading, sound parts would suffer equally with the diseased.

Mr. Hunter employed the lunar caustic in two modes which I shall describe, with the phenomena resulting from its application, before explaining the method which I have myself practised.

His first mode was to pass it by a large silver canula, of the proper curvature, down to the stricture. To make the canula enter, and to prevent the accumulation of mucus in its extremity, he filled this up during the introduction, by a hemispherical button, fixed to the end of a wire. At the other end of this wire, the caustic was held by a kind of porte-crayon; and on the canula's reaching the stricture, the button end of the wire was withdrawn, and the caustic introduced in its stead. When the caustic had pressed moderately against the stricture for about a minute, it was drawn within the tube, and the whole apparatus extracted. He finished the

operation by injecting some water, or by desiring the patient to void his urine, to wash off any of the caustic, which by remaining might hurt the parts. From the unyielding nature of this canula, he found it difficult to apply the caustic exactly to the surface of the stricture, and therefore, when the obstacle was at the bend of the urethra, there was considerable risk of burning a false passage under the true one. The employment of a flexible canula remedied, in part, this defect; but he ultimately preferred a wax-cloth bougie, with a bit of caustic inserted into the end of it. Sir Everard Home was the first who gave an account of this latter method, and from his work the following description is taken.

"Take a bougie, of a size that can be readily passed down to the stricture, and insert a small piece of lunar caustic into the end of it, exposing the surface of the caustic, but surrounding it every where laterally by the substance of the bougie. This should be done some little time before it is used; for the materials of which the bougie is composed become warm and soft by being handled in inserting the caustic; and therefore, the hold the bougie has of the caustic is rendered more secure after it has been allowed to cool and harden. This bougie, so prepared, is to be oiled, and made

ready for use; but previous to passing it, a common bougie, of the same size, is to be introduced down to the stricture, to clear the canal, and to measure exactly the distance of the stricture from the external orifice; this distance being marked upon the armed bougie, it is to be passed down to the stricture immediately on the other being withdrawn. In its passage, the caustic is scarcely allowed to come in contact with any part of the membrane, the point of the bougie, of which it forms the central part, always moving in the middle line of the canal; and indeed the quickness with which it is conveyed to the stricture, prevents any injury to the membrane when it is accidentally brought to oppose it."

The caustic should never be kept in contact with the stricture above a minute, uor often above half a minute, especially in irritable subjects, and at the commencement of the practice. A slough, or pellicle of dead matter, is formed by each application, which ought to separate from the remaining part of the stricture before the caustic is repeated. Two or three days may be commonly required for this separation, and the patient should carefully notice it. If large, the dead matter may be discharged in one bit, and if small, little filaments observable on passing the urine will commonly give intimation of its

removal; or the increased sensibility of the parts on the passage of the urine will strengthen our presumption that this has taken place.

After allowing a reasonable time for the separation of the slough, when it has passed without being seen, if no great degree of irritation be present, the caustic is to be again applied, and the treatment continued in this manner till a bougie can pass through the stricture. Home, who had the permanent removal of the stricture in view, insists on the propriety of using caustic till a full-sized bougie can pass, and directs that for this purpose as thick a piece be employed as can be readily passed down to it; but as Hunter used the caustic chiefly in cases where he could not introduce the bougie at all, as soon as the stricture was wide enough to admit a small one, he laid the caustic aside.

The patient experiences a burning pain almost immediately on the caustic touching the stricture, but not very acute, nor of long continuance; and unless the application be severe, irritation seldom ensues. The supposition that great irritation would follow the caustic, deterred Surgeons, for some time after Mr. Hunter's publication, from attempting the cure of stricture by it, and a great merit of Sir Everard Home's work was, that his numerous col-

lection of cases proved how groundless these terrors were. He has shown, even by reference to cases, that if a small bit of caustic should accidentally drop from the point of the bougie, and remain in the canal, no great mischief need be dreaded. It is a good rule, however, during the use of caustic, to avoid all additional causes of irritation.—The number of applications necessary to the destruction of a stricture will, of course, depend on its length and consistence, and on the correctness and duration of the several applications. One severe touching may remove a short stricture, while fifty have been insufficient in cases of a different description.

Several disagreeable circumstances may occur during the prosecution of the treatment by caustic, as it is usually applied.

Of these, hemorrhage may be first considered; an unpleasant occurrence, but generally, from the small quantity of blood lost, more terrifying to the patient, than noxious to his constitution. Several pints of blood, however, have flowed at once, from the caustic's having probably opened a passage into the corpus spongiosum; a circumstance which greatly weakens the patient, and retards the cure of the stricture. What constitutes the danger of this hemorrhage is, that Surgeons have hitherto been obliged to

leave the stopping of it almost entirely to the efforts of nature. It would be dangerous to close the canal anterior to the stricture, as the blood would then flow into the bladder, coagulate there, and prove an obstinate cause of retention of urine; and the only other means they had for moderating it, were astringent injections, cold external applications, and external pressure. We have now, however, in the dilator, a means which will arrest such a discharge instantly; pressure may be made by it, either directly on the bleeding vessels, or, in permeable strictures, behind them, while the anterior extremity of the urethra is closed.

We have seen that a violent paroxysm of fever is an occasional symptom in cases of stricture. The same affection sometimes follows the employment of caustic, and in old or irritable cases may be so violent, or so liable to recur a few minutes after every touching, as to render perseverance in the plan by caustic dangerous. These paroxysms always debilitate the patient, and have occasionally proved fatal. Sir Everard Home, whose experience in the treatment by caustic has exceeded perhaps that of any other Surgeon, mentions, that such paroxysms were particularly apt to occur when the cure was nearly completed, or just before a large bougie could

pass on to the next stricture, or to the bladder. From a consideration of this fact, and the circumstance that hemorrhage generally occurs about the same period of the cure, I thought it advisable, whilst engaged in practice of this sort amongst patients who had been long in India, and were consequently particularly disposed to this affection, not to employ the caustic to the same extent, and I found that by this limitation, the paroxysm was a very rare occurrence. This difference in practice was moreover founded on the idea, that all obstructions in the urethra can seldom be, in their whole length, of the same consistence, and that, although the caustic may be more effectual than the bougie for destroying the anterior harder part of the stricture, yet as the posterior portion of this is generally more soft, vascular, and irritable, being chiefly a swelling of the coats from inflammation, excited there by the resistance to the urine, it by no means requires nor admits of such a powerful remedy for its removal. When these paroxysms occur, however, in spite of every precaution, a cooling laxative and sudorific have been found useful in promoting their speedy subsidence.

That danger may be incurred in the treatment by caustic, from the slough on its separation plug-

ging up the passage, is certainly possible; but I have never as yet observed it in practice, nor can I easily conceive how such an obstruction could resist the stream of urine, or the introduction of a bougie.

The pain and spasms from caustic have been mentioned as reasons against preferring it to the bougie; but I doubt whether, on an average, more distress is not experienced by the tedious and irritating employment of the latter.

The last and most powerful argument against the application of caustic, is, the danger of its burning a new or false passage, either into the body of the penis, or more commonly, through the cellular substance between the urethra and the rectum. This has been a very frequent occurrence, and when we reflect on the hitherto imperfect mode of applying the caustic, and that there have been as yet no satisfactory means of discovering the length of the stricture, we see that in the attempt to burrow through one of the long kind, there are many chances of the caustic's leaving the line of the urethra; and even in short strictures, especially when they are hard, the same disastrous occurrence is liable to happen, from the caustic solution acting chiefly on the lower side of the canal. To obviate

this danger, we have been desired to press, from time to time, a soft bougie against the stricture, and thus to obtain an idea of the advances made, and whether or not the caustic holds the proper course through the stricture.

Section V.

On a new Method of applying Caustic to Stricture.

The injurious consequences from the use of caustic, enumerated at the close of the last Section, will be found to proceed chiefly from the defective methods of applying it hitherto in use. It is by burning unequally or too much, or, in other words, by not having its action confined to the diseased part, that false passage is formed, that hemorrhage occurs, that the violent paroxysm of fever is produced; and from the uncertainty of the Surgeon's making the application exactly to the spot intended to be destroyed, arises, in general, also, the tediousness of the cure.

I am now going to describe a new method of applying caustic to strictures which I have used, and which obviates the defects of all the former methods.

As it is important, previous to any application of caustic, to know exactly the state of the parts, I will first explain a more complete mode of sounding or examining the urethra than has yet been practised. It is a modification of the dilator which supplies us with a perfect urethra sound, for discovering, not only the length of strictures, but their number and relative situations. Little attention has been paid to the two last mentioned circumstances, because no means was known of removing more than one stricture at a time, and Surgeons accordingly, and merely for the sake of prognosis, had been content to conjecture, that if a stricture occurs in old cases before the bulb, one more, at least, will be found nearer the bladder. The canula of the dilator sound should be stiff and very narrow, and the bag very short, nearly of the natural diameter of the urethra, with its extremities as flat as possible.* It is introduced to the first stricture, and the distance from the orifice of the urethra observed; letting out the air, it is then passed through the narrowing, again distended and retracted, till the posterior surface of the same stricture opposes it; the distance of this from the end of the canal is then

* Pl. I. Fig. 4.

marked, and the space between this mark and the former shows the extent of the urethra occupied by the stricture. The instrument is now passed to another stricture, the same process repeated if deemed necessary, and so on till the whole length of the urethra is examined.*

By feeling from without the impression made by

* [" M. Ducamp a inventé, pour mesurer la longueur des rétrécissemens, un instrument qui, étant introduit au moyen d'un conducteur, se déploie au delà de l'obstacle, et forme une espèce de tête ; en retirant doucement cet instrument, sa tête est retenue par l'obstacle, de manière que la distance qui se trouve entre cette tête et l'extrémité du conducteur indique la longueur du rétrécissement."—Rapport, &c. par MM. Deschamps et Percy.

In the construction of this apparatus, the true principle of an instrument for ascertaining the number and extent of strictures, which was exhibited to M. Ducamp in the dilator sound, is adhered to, viz. the capability of being enlarged when it has passed beyond the obstruction ; but in other respects, which it would be tedious to specify, the apparatus he substituted has been found too defective to be used by practitioners. A variety of sounds constructed with the same view, might be made on some of the plans hinted at in page 190, but none would probably, in simplicity and ease of management, excel that which has been described above. The value of this means in ascertaining whether the obstacle to the passage of a bougie arises from disease or the natural impediments of the canal, has already been alluded to. For this purpose the small membranous bag must be passed to the bladder, then inflated, and withdrawn in the inflated state. The dilator sound is likewise useful in determining the exact situation and extent of other diseases of the urethra (and the same mode of exploration is applicable to other canals) by noticing the distance of the seat of pain excited by its distension from the orifice.]

a stricture on the distended tube of a long dilator lying in it, I have been able on some occasions to ascertain its length with considerable precision.

The means generally in use for examining the urethra in such cases, are these :

1st. To introduce a bougie through the stricture, and to observe whether it passes it with a sensible jerk ; if so, it is supposed to be a thread stricture. This criterion, however, cannot be depended upon, as the differences of consistence, with a thousand other circumstances, would continually mislead us.

2d. Others form an opinion from this : they pass a soft bougie through the stricture, and on its being withdrawn, if a transverse groove or indentation be observable upon it, they presume that the stricture is short ; but if no groove is discovered, they deem it of the riband species. Were violent spasm of a short stricture to be excited by the bougie lying in its opening, and the spasm to cease, a groove might certainly appear on the bougie when extracted ; but if no spasm should arise, or having arisen, should continue during the extraction of the bougie, the groove would be little observable, and the form of the point of the instrument would, as far as it had been introduced, be throughout equally lessened.

Sir Charles Bell proposed a very ingenious means

of examining the urethra : it is to use wires, terminated by silver balls of different sizes, and to try until one be found that will just pass into the stricture; then by attending to whether the ball moves along easily, as in the healthy wide urethra, or with difficulty, as in a narrowing, to judge of the length of the stricture. When we reflect upon the irritability of the diseased canal, and the pain and spasm likely to be produced by pushing the ball through irritable portions, we see the sources of error to which the feeling of the operator is exposed ; and if a narrow stricture exist anteriorly, none beyond it can be felt.

The new method of applying caustic is this: having sounded the canal as described, and ascertained the size of the passage through the stricture, I pass a full sized canula down to it, and then through this, the caustic, previously prepared in the following manner. A short cylindrical bit is chosen, of diameter rather less than the stricture, and it is pierced so that a wire may pass through its axis ; this wire has a ring end to be held by, and is a little longer than the canula. Half an inch of it is then passed through the caustic, and is covered by a piece of common bougie, that it may pass through the stricture without chance of wounding the urethra, and behind the caustic another portion of the wire is

surrounded by bougie, in order that the caustic may be firmly held half an inch from the point of the wire.* The wire thus armed, is passed down the canula, and the bougie point entering the stricture, conducts the caustic exactly into it. The canula, during introduction, has its open extremity filled and rounded by a button, projecting from it as already described, and when close down, the button is withdrawn with the wire to which it is fixed. On the other end of this wire a little dossil of lint is fixed, which is introduced before the caustic, to absorb any superfluous moisture at the stricture, and after it again, to take up any dissolved caustic which might spread in the canal. The time during which the caustic should remain touching the stricture, and the repetitions of the application, are regulated by the ordinary rules. †

* Plate I.

† ["Ayant acquis les connaissances qui lui sont nécessaires sur la forme et l'étendue du rétrécissement, M. Ducamp y porte le caustique avec assurance et avec toute la précision désirable, au moyen d'un instrument qu'il nomme *porte-caustique*. Cet instrument est terminé par une douille de platine qui sert de gaîne à un petit cylindre de même métal, lequel porte une rainure chargée de caustique : arrivé sur le lieu qu'on veut cautériser, ce cylindre sort de sa gaîne, entre dans l'obstacle, et, en faisant décrire à l'instrument des mouvemens plus ou moins étendus, on peut à volonté cautériser toute la circonférence du point rétréci du canal, ou seulement l'une ou l'autre de ses parois."—Rapport par MM. Deschamps et Percy.

The following are the advantages of this method over that proposed by Mr. Hunter. A very great one is, the impossibility of its making a false passage in whatever kind of stricture it may be employed. Even though the caustic should be applied to the anterior surface of the stricture only, the projecting guide would prevent this hazard.

If the stricture be chiefly from spasm, the action of the caustic on the innermost fibres may suddenly remove all the worst symptoms of obstruction, as these fibres may be the only irritable ones, and the rest of the stricture but a portion of the membrane of the urethra, drawn inwards by them from its natural position. I cannot otherwise account for the

It is obvious that a variety of instruments may be constructed on the principle of confining the action of the caustic to the interior of the stricture. That which I have described is perhaps the simplest, and it has this advantage, that such an instrument may be prepared by the Surgeon himself, using means always within his reach. Modifications of the plan of introducing a cylindrical surface of caustic occurred to me as I proceeded. Instead of drilling the caustic, I found that piercing it with a hot wire was more convenient; and latterly, on experiencing the difficulty of thus preparing a wire to pass certain kinds of narrow stricture, which it was yet desirable to cauterize, I covered it with a layer of melted caustic, and contrived that, in other cases, the due diameter should be obtained by the thickness of the metal on which the caustic was cast. The details of the subject will be more conveniently given when the figures illustrating the apparatus are described.]

frequent sudden relief of obstruction that has followed this practice.

But whatever may be the nature of the stricture, by every partial destruction of its inner surface, its calibre must be enlarged. Whereas it has been often objected to caustic, as hitherto employed, that it may be applied to the anterior surface of a long stricture for months, without at all relieving the symptoms.

As the action of the caustic is confined to the stricture, as well from being applied to its inside only, and passed to it in a canula, as by the employment of the sponge, which prevents the spreading much better than the injection of water, all unnecessary pain and spasm will be prevented.

Besides, by its immediate action on the irritable inner fibres, the risk of spasmodical retention of urine will be very much diminished.

For the same reason that false passages and unnecessary pain are prevented, the occurrence of hemorrhage will be very unfrequent, as there is no danger of breaking into the cells of the corpus spongiosum.

I shall subjoin the following remarks, for the purpose of obviating such objections as I conceive may be made to this new method.

If the opening of the stricture should not be ex-

actly in the centre of the urethra as usual, it will be proper, to ensure the destruction of the stricture only, to cover part of the caustic previous to using it with wax, or other similar substance, to limit its action; and to examine, from time to time, by the introduction of a soft bougie, whether the effect be what is desired.

No fear need be entertained, when using the caustic in this way, of harm arising from its breaking and remaining in the urethra; for if the canula be kept close to the stricture, any particle that might accidentally drop from the wire, must be drawn again into the canula, by the end of the returning guide.

However superior caustic, employed in this improved manner, may be to the common dilating bougie in the cure of stricture, as really upon the whole producing less pain and irritation, and being certainly of much speedier benefit, while it has also more permanent effect from its capability of burning to any extent the sides of the stricture closely applied to it; still, from the almost universal applicability of the dilator, the cases requiring the caustic will not be numerous. If no bougie can be made to pass, by ordinary means, or by the employment of the various new expedients which have been proposed, this method of applying caustic cannot of course be used,

and the question will then be, whether Hunter's caustic bougie, or some of the plans about to be mentioned, is to be preferred. A great objection to the use of caustic in such cases is, that, from the impossibility of measuring the length of the stricture by the sound, we may apply it to one of the long kind, and the inflammation which might succeed would be apt to close the impermeable opening entirely.

[The great advantage of applying caustic to the interior part of strictures instead of the face or anterior part, after obtaining a precise idea of their form and extent, was immediately perceived by the Surgeons of France, and the use of this powerful remedy, which, notwithstanding the recommendation of the illustrious Hunter, and its general employment by the English, had been long proscribed in that country on account of the dangers attendant on its imperfect mode of application, was again adopted with avidity as a substitute for the harassing and inefficient treatment by the bougie. We learn from the medical publications of the time, that many persons thus obtained speedy and per-

manent relief, who had lived for years in a state of hopeless misery in consequence of their diseases having resisted all the usual remedial measures. Yet, great as this improvement was on the common practice or routine, it would appear that in consequence of the determination of M. Ducamp to modify every one of the new proposals which he adopted, this mode of applying caustic was in danger of sharing the same fate in France which befell the proposed improvements in the cure of stricture by dilatation. Professor Lallemand assures us, that at the time of his own publication on the subject (which had the merit of pointing out one essential point in which M. Ducamp had failed in applying the principle of the new method) Surgeons were beginning to discover that the plan which had been proposed for confining the action of the caustic to the obstructing part, was by no means so certain as had been supposed, and, in fact, that the frequent occurrence of injury to the sound parts was bringing the new method into some discredit.

We shall now proceed to point out the leading circumstances to be provided for in the construction of instruments for the purpose of cauterizing exclusively the interior part of stricture; and to ex-

plain in what respects the instruments contrived by M. Ducamp and others are defective.

1. Care must be taken that the caustic shall not be applied to the sound part of the canal on either side of the stricture. There is no difficulty in avoiding that part of the canal which is in front, provided means are adopted of causing the caustic certainly to enter the stricture, and that the conducting tube through which the caustic is introduced, is kept pressing against its face. To avoid the canal behind, it is necessary to ascertain the extent or length of the stricture. The dilator sound is the best means of measuring stricture. The modification of this which M. Ducamp contrived not being found to answer, he extended the plan which I had recommended, of using a very soft composition for taking an impression of the face of a stricture, to taking one of its interior or channel; but the objections to the common soft bougie, already adverted to, when relied upon for this information, apply still more strongly to one of less resisting material. Nevertheless, should the marks impressed on the sides of common plaster bougies, which have remained for some time within the stricture, be uniform in appearance, they will give useful informa-

tion in this respect, and will confirm the opinions drawn from the use of the dilator sound. It ought to be a rule, that, unless the most accurate knowledge of the extent to which the canal is contracted can be obtained, caustic should never be employed at least for the destruction of substance, but in the mode appropriate to the shortest kind of stricture.

2. The caustic must be conveyed with certainty into the stricture. It was for this purpose principally that the conducting point was added to the original apparatus. M. Ducamp took this away, as he had done the silk tube of the fluid dilator, and with a similar consequence in both cases, namely, that the remedy applied has not been confined in its action to the part on which alone it is intended to act. It has been asserted, indeed, that the caustic in M. Ducamp's apparatus has been as frequently allowed to dissolve in front of the stricture as within it, from the receding of the stricture on pressure, or the extension of the urethra, giving the deceptive appearance of the instrument having entered; and hence have followed the several dangers forming the objection to former methods.

3. When the opening through the stricture is in its centre, as it usually is, the caustic should be applied uniformly to its interior surface. In the

original plan, this is accomplished by graduating the size of the caustic according to that of the opening, and by completely surrounding the penetrating wire with caustic. M. Ducamp, by using a small cylindrical projection containing the caustic on one side, could only, if the instrument had been kept motionless, cauterize that point of the contracted or collapsed orifice which happened to come in contact with the caustic; and although rotating the instrument would be nearly equivalent to having the whole circumference of caustic, in the bend of the urethra where strictures usually occur, such rotation is difficult, even with the aid of any of the various expedients to supply this defect that were afterwards adopted.

These glaring defects in M. Ducamp's apparatus naturally led to the contrivance of numerous others, by which it was supposed the principle of interior and exclusive cauterization could be more perfectly applied. Of these contrivances I shall notice that of M. Lallemand, as well on account of the celebrity of the proposer, as from its being, I believe, the apparatus generally used. It consists essentially of a narrow straight or crooked platina tube, having in its cavity a long thick wire, on the end of which there is a groove for containing the fused

caustic. In applying the apparatus, it is first passed a little way beyond the stricture, so as to bring the caustic on the wire, as nearly as can be done, opposite to this; the tube is then drawn over the wire, which is kept fixed in its place, and the caustic in its groove comes thus in contact with the stricture. When the caustic has been applied for the due period, the wire is drawn within the tube, and the whole apparatus extracted.

M. Lallemand's instrument has the peculiarity of enabling the Surgeon to cauterize a number of strictures in succession, if circumstances render it prudent to venture on such a proceeding, or of applying the caustic to any particular stricture. Its greatest defect is the difficulty of ascertaining when the caustic is precisely in contact with the stricture, as the previous measurements of the urethra, on which he depends, are of little avail in consequence of its extensibility. M. Lallemand judges of the length of a stricture not only by the mark on the side of a soft bougie, but by the length of the projecting part of a soft bougie which has been pressed against its face; we have already explained why little faith can be placed in the first of these means, and the other can obviously afford no information of the kind. In using this instrument,

there is the same difficulty of cauterizing the whole circumference of a stricture, that we have noticed as a defect in the contrivance of M. Ducamp.

It was stated in a previous Section that caustic is often employed to allay the morbid irritability of stricture; it acts on this occasion as it does in relieving similar conditions of the mucous membrane of the eye, or when applied to the surface of irritable ulcers. But in addition to this, it produces a powerful and peculiar effect on the vital actions of the part. Its mode of operation in effecting these changes is not well understood; the subject has been much investigated of late years, and several ingenious explanations have been offered, but not of sufficient practical importance to require being mentioned in this place: we must be contented with a knowledge of the fact, that the action of caustic is often highly beneficial in stricture independently of any destruction of substance caused by it. It would appear, from the circumstance of the mucous membrane having been found entire in certain cases where severe applications of caustic had been made, that what have been supposed to be eschars or detached pieces of the destroyed substance, are often merely

exudations on its surface, or coagulated secretions. Part of the beneficial action of caustic may be very generally attributed to this peculiar effect of the remedy, when the Surgeon's principal object is to destroy the morbid structure; and it is often desirable, by shortening the duration of its contact with the diseased surface, to limit its action to this effect. Applied in this manner, caustic is in many cases a valuable auxiliary to dilatation; and such an use of it has found zealous advocates even amongst those who disapprove of employing it so as to cause destruction of the part.

It has been objected to the employment of caustic with a view of killing the part, and thus reducing it to the proper level, that the cicatrix which succeeds will contract the urethra, and form the stricture anew. Notwithstanding that this objection is opposed by the well established fact, that organic stricture may be permanently removed by caustic, it agrees so well with what is observed in regard to the process of cicatrization in other parts, that it is at least prudent to obviate the disposition to such contraction by the employment of suitable dilatation. With or without such a precaution, the destruction of the stricture is, in certain obstinate cases of this disease, a valuable resource when all milder

measures have failed. I have sometimes employed caustic, in the first stage of the treatment, in such a manner as to destroy the substance of stricture, and afterwards, while dilating that part of it which was probably less changed from the natural structure, and in which the vital actions were more energetic, and consequently more likely to assist in the curative process, I have applied the caustic in a milder way, with the intention only of producing its alterative operation. In hard cartilaginous strictures the application of caustic, if completely confined to the altered surface by the expert use of the means which have been recommended, is, instead of being a painful operation, frequently unaccompanied with any sensation beyond a little heat in the part; and the occurrence of pain, as the treatment proceeds, may sometimes indicate that the more disorganized part has been removed, and that a change of measures is advisable.

The Surgeons of this country would seem to be still under the influence of the general condemnation of caustic, which its abuse in being applied, in a very imperfect mode, to cases of almost every description, occasioned many years ago. The mode of applying it, however, to the interior of strictures, that it may act from within outwards, is now beginning

to be adopted and to be duly appreciated. In the London Medical Gazette for last year, there is a paper by Mr. Curling, containing the results of his experience in the use of interior cauterization ; and other notices recommendatory of the plan have recently appeared. Although the necessity of destroying the substance of stricture in order to effect a permanent cure will, it is hoped, be generally superseded by the employment of the due degree of dilatation which the fluid dilator enables us to accomplish ; yet, if the Surgeon be furnished with means both for ascertaining precisely the extent of the diseased surface, and for limiting the application of caustic to it, he will not probably hesitate to use it, so as to produce its alterative and sedative action, in other affections of the urethra as well as in stricture, when daily experience shows him its great utility, when so employed, in a variety of similar morbid conditions of the mucous membrane of the eye, throat, rectum, vagina, &c. We have already (at page 140) adverted to the extraordinary benefit from mild applications of caustic in that disease of the prostatic part of the urethra, which was first described by Mr. Abernethy, and has been subsequently investigated with great care by M. Lallemand.*]

* Abernethy " On Diseases of the Urethra ;" Lallemand " Sur les Pertes Seminales Involontaires."

Section VI.

Of Rupturing Stricture.

The speedy widening of a stricture is sometimes effected by pushing forcibly into it a sound or catheter, in order to break it down or rupture it. This, like the caustic, is a very old practice lately revived; but it is hazardous and painful, and therefore improper, wherever a safer method can be substituted. If a stricture of soft consistence occupy no great extent of the canal, and the point of a conical instrument can be introduced a little way into its passage, by forcing this on, the muscular contraction may either be suddenly relaxed, or the stricture ruptured into several bleeding caruncles, which must afterwards be removed by the use of a bougie. But if, on the other hand, and which is by far more likely, the stricture be long, of harder texture than the adjoining urethra, or the point of the instrument cannot be properly lodged in its opening, it is evident that if this method of rupturing be adopted, the instrument will be more apt to tear the urethra anterior to the stricture, than the harder stricture itself, and may thus produce great hemorrhage, and false passage.

It is, only in narrow permanent strictures, therefore, where no instrument can pass without rupturing, or where close spasm cannot be otherwise removed, and when the point of a conical instrument can be correctly applied, that it may be allowable for a dexterous Surgeon to use force, but under no other circumstances.

In cases where the stricture is short, and will not yield to gradual dilatation, if it be deemed proper to open the canal immediately, and there is yet room for the dilator to pass through the stricture, it may be ruptured without the forementioned danger, by distending it suddenly with a dilator of powerful action.

Section VII.

Of Destroying Stricture by Ulceration.

Although ulceration of the stricture may be produced by most of the methods of clearing the canal, I mention it separately, because it was once the practice of Surgeons to endeavour thus to destroy every kind of stricture, by applying considerable pressure against them with a bougie, or some other similar

instrument. This measure, however, is so painful and slow in operation, that in the present state of our knowledge of the treatment of stricture, the practitioner, who, under ordinary circumstances, should attempt it, would not often be left to consult his own judgment about the propriety of continuing it.

The pain and confinement, we have already stated, are the chief objections to the French method of curing stricture by leaving a catheter in the canal. This, in many instances, probably operates more by producing ulceration than simple dilatation of the stricture. If the stricture be very narrow, a metallic catheter is first forced through it into the bladder, which, after remaining four or five days, is replaced by a larger catheter of elastic gum, and this, after the same period, by one still larger, and so on until the obstruction is removed.

[I have been unwilling to make so considerable an alteration as to leave out the two last Sections, notwithstanding that their contents may be said

to have been anticipated by the new matter of this edition.

The difficulty stated at the beginning of the Chapter, of making a satisfactory classification of the methods of cure, is particularly felt as respects the subjects of these Sections, which refer principally to the class of strictures called impermeable. We have seen that in cases of retention of urine from stricture, it has been usual to keep a bougie in the canal lying in contact with the stricture; and we have noticed some of the various explanations which have been given of its mode of operation. Dupuytren was in the habit of treating strictures impervious to instruments, by allowing a bougie thus to remain in the passage for a very long period; and upon the stricture's yielding sufficiently to admit the conical point of the instrument, he contrived, after inserting this, to keep it slightly pressing onwards. In the old practice adverted to above, it was the rule in cases of impermeable stricture, that a bougie should be kept pressing constantly against its face; and although the shifting of the instrument or the extension of the penis would probably in most instances convert this into an intermitting pressure, it is better to cause such pressure by the occasional introduction of the bougie, as the danger of making

a breach through the urethra and a false passage is thereby in a great measure prevented.*

These various practices in cases of impermeable stricture may admit of a division into those where no pressure is made by an instrument, (the two first enumerated,) and those in which pressure is made; but it is evident that they are all closely allied, and that the greatest difference between some of them is only that of the degree of remedial action, whatever this may be, which is excited.

Which of these practices is to be preferred, must be determined as much by the circumstances or convenience of the patient, as by the state of the

* [Amongst the cases published as an appendix to this work in 1821, there is one in which such a method was adopted with success. The following is an extract from it. * * * "I again endeavoured to pass the instrument beyond the farther stricture, but notwithstanding the employment of the auxiliary measure of the elastic canula, I could not succeed. For the elastic tube I then substituted a large cylindrical wax-cloth bougie, which I pressed moderately against the stricture for a minute or two every day, for nearly a week, generally attempting, after every such application, to pass a small instrument. On the last application of the large bougie it went suddenly through and passed on to the bladder."

The mode in which the bougie acts when thus applied to the face of a stricture, must be very similar to its mode of operation when employed in the usual manner. In the case related, mechanical dilatation was probably the principal remedial effect of the pressure.]

disease. What has already been said, in preceding parts of the work, renders any further observations on this point unnecessary. The more hazardous measure of forcing either a blunt or a conical instrument through a stricture is only to be resorted to when the urgency of symptoms calls for immediate relief: but if the means which have been described of facilitating the passage of small instruments be expertly and perseveringly employed, there will be seldom occasion for the adoption of any of the severer measures now adverted to, or of those which will be the subject of the ensuing Section.

Section VIII.

Of the Treatment of Stricture by Cutting.

When the urine is obstinately retained by closure of the passage through a stricture, and there is reason for supposing that the stricture is short, by the little space observed between the urethra behind the stricture when full of urine, and a bougie, or the dilator before it, it may be advisable, when other methods have failed, to attempt the patient's relief by piercing the stricture. This may be accomplished by passing

a stilet in a canula down to the stricture, and perforating it, while the patient distends the urethra behind it with urine. Such an operation is recommended in books of surgery ; but without a means of stopping the hemorrhage that might be caused by the stilet's accidentally piercing the corpus spongiosum, the patient would incur considerable danger. Since we have the dilator, however, which can press directly upon the bleeding vessels, this hazard is completely removed, and thus another means is obtained, whereby we may sometines avoid the operation of puncturing the bladder.

But in cases where no perforation is necessary on account of retention, it has still been proposed, for the purpose of accelerating the cure, to slit open the stricture by passing through it a probe pointed trocar, made to cut on withdrawing. And I have read somewhere of a knife for the same use, consisting of two cutting blades, which being passed through the stricture in a sheath, are then expanded like the sides of the letter T, and on withdrawing, cut with their inner edges. Those methods, however, of slitting the stricture, labour, like rupturing, under this defect, that they still leave the obstructing substance, though in another shape, which requires for its complete removal, and to prevent the divided

edges again growing together, the constant and painful presence of the bougie.

There is, however, another means of cutting, or rather of cutting out strictures, which the invention of the dilator enables us to practise, and which has not the defects of the operations just mentioned. It seems applicable in cases where the stricture has a peculiar tendency to return, or where the existence of a false passage renders the attempt to cure by dilatation abortive.

In this operation, which resembles in some respects that of cutting out a portion of the cranium by the trephine, the whole substance forming the stricture is instantly removed by one push and turn of a circular knife carried against it. Before cutting, the urethra before and behind the stricture is fully distended, the outer portion by a large canula introduced down to the stricture, and the inner by a dilator which has been passed through it, and drawn close against its posterior surface, so that the stricture itself remains compressed between these two, and projecting inwards. The knife, then, like a second canula issuing from the first, makes its way through to the dilator, and detaches the whole of the stricture, which comes away in its tube. The canula and knife are then withdrawn from the urethra, but the

dilator remains, brought forward upon the newly cut surface, to stop the hemorrhage. The knife is managed by a wire handle, by which the operator gives it the forward and turning motion necessary; and lest in passing through the stricture it cut into the dilator (if an air one be used) before the excision of the stricture is complete, the dilator is made to recede a little, as the knife advances.

This operation promises, from its speedy, safe, and effectual action, to be a fitter remedy for the cases of stricture above mentioned, than any of the other methods; and the momentary pain will generally be less than that proceeding from a single application of the caustic bougie.*

When a false passage has been made by the in-

* [M. Amussat has, of late years, been the principal advocate for the incision of stricture. His first notices on the subject appeared in the French Medical Journals of the year 1824; and we are told by one of his pupils, that he was engaged in the contrivance of instruments for the purpose "avant même d'avoir lu dans Sœmmering que le chirurgeon Doerner avait proposé de traverser les rétrécissemens avec une lancette renfermée dans une sonde," &c. One of M. Amussat's operations consists in passing an instrument with lancet edges through the stricture, directing it by a wire previously introduced. Another operation is intended for cutting out the part, and exactly resembles that which is proposed above for the same purpose. He first passes an instrument through to sustain the stricture, which he then removes by a circular knife.]

cautious use of instruments, it is often a very difficult matter to act again upon the stricture, which is therefore generally left increasing, till sudden suppression of urine from spasm, or the patient's aggravated misery from great organic obstruction, require something decisive to be done.

John Hunter first proposed an operation for the case where no instrument could be passed with advantage in such circumstances, which was this:—He cut down upon the stricture from the perinæum, introduced a canula by the wound, until it was close to the posterior surface of the stricture, and another by the orifice of the urethra, to its anterior surface; and then, while the canulæ were held steadily in a line, he pierced the stricture between them; the operation was concluded by removing the canulæ, and by passing a catheter into the bladder. The urethra at length heals over the catheter which is constantly retained in it, in order to remove the stricture; and, by drawing the urine off, to prevent this from reaching the wound, which would otherwise be irritated, and become fistulous, or indisposed to heal.

When an instrument has made advances in the canal, without in any degree relieving the obstruction of the urine, Surgeons suspect the formation of a false passage: but as yet there have been no means proposed for ascertaining this with certainty,

nor for discovering the seat of a stricture in the canal, when such passage has rendered it impossible to proceed with the ordinary methods of cure. This, indeed, was of little consequence, while we had only the old modes of treatment; but now, as several means are in our choice, by which, provided we can introduce an instrument through the stricture, it may be speedily cured, a method of ascertaining these points becomes of great importance, as it might prevent the necessity of the operation proposed by Mr. Hunter, which, from the hemorrhage attending it, and the collapsed state of the urethra, would be severe and frequently very difficult of performance. A method which I have used, is the following:—let a small silver tube, with a very short dilator bag or button at its end, of a diameter that when distended in any part of the urethra will prevent the passage of the urine by its sides, be introduced as far as possible, and dilated. If the urine flow by the side of the canula, and not through it, we may be sure there exists a false passage, and that the bag of the dilator has passed into it; and the change, as we withdraw the instrument, from the urine passing by its sides, to its being discharged through the canula, or its complete stoppage, will indicate the precise seat of the stricture. In complete retention of urine, this method is evidently

inapplicable; we can then only endeavour to pass an instrument, with its end turned up, (as the false passage is almost invariably on the lower side of the urethra,) in that part of the canal which may be supposed the likeliest seat of the stricture, from its narrowness, or from the information the patient can give.

It was once the usual practice in obstinate cases of stricture, and may be still requisite in some very uncommon instances, to cut down upon the obstruction from the outside, divide it with the knife, and heal the canal over a catheter remaining in the urethra. The incision through the skin in this operation, and in cases where it is necessary to open the urethra on account of a false passage, is directed by feeling the end of an instrument passed down to the obstruction.

[Since the above remarks were published, cutting instruments have been much employed in diseases of the urethra and in each of the modes that have been described: they have been employed for piercing impermeable strictures; for cutting out strictures,

or scarifying cartilaginous enlargements from the inside; and for dividing impermeable stricture, previously cutdown upon from the outside. These methods may have been better received than perhaps they deserved, from the notion that they were new; but although a perusal of the foregoing observations will show that this idea was erroneous, it would be wrong to conclude, because a remedy has fallen into disuse, that it must have been abandoned with just cause. Besides, a slight modification of the means may convert into a comparatively safe operation that which was before a dangerous one; and it is probable that improvements have been made on most of the plans in which the knife has been adopted. That the danger which attends the operation of piercing strictures is not so great as would, à priori, be supposed, is, I think, satisfactorily shown by the results of Mr. Stafford's experience; and it may be mentioned in favour of this plan, that Dr. Physick, the celebrated American Surgeon, is recorded to have frequently adopted it with success. Although I have, as yet, never had occasion to pierce a stricture, having always succeeded in giving relief in urgent cases by the use of less hazardous measures, I have, repeatedly employed internal incision as an auxiliary to other measures, in obsti-

nate stricture of the spongy part of the urethra, and with considerable advantage. In addition to the danger of hæmorrhage and infiltration of urine from the operation of piercing, as a new channel must be generally formed by it in cases of long stricture, there is the objection, that it would be difficult to keep the passage open without a constant use of instruments.

The operation of dividing a stricture from the perinæum, or *boutonnière*, as it was formerly called, has of, late years, been frequently practised in this country. It is, however, in some instances, a difficult and a severe operation, and the circumstance of able Surgeons having attempted it without success, has again brought it into discredit. It has, moreover, the disadvantage, in common with all the other modes of using the knife, that the relief from it can only be of short duration; for if other means are not assiduously employed afterwards, the cicatrix by which the incision heals will soon renew the contraction. Still, cases may occur in which after the failure of all the other measures, this operation may be advisable; and when the adjoining parts have not been much altered by disease, and the stricture is not very deep in the canal, little difficulty will be experienced in its performance.]

APPENDIX.

OF OTHER APPLICATIONS OF THE DILATOR.

The dilator is a new instrument in surgery, applicable to many other cases besides stricture of the urethra. The following may be the principal of these :—

1. In strictures of the œsophagus and rectum.

After what has been said respecting the use of the dilator in examining and curing stricture of the urethra, it were unnecessary to enlarge upon its application to these.

2. In chronic enlargement of the prostate gland.

The obstruction to the urine from this disease generally arises from the projection of the middle part of the gland into the lower part of the channel of the urethra. The common local remedy is a catheter passed through the obstruction ; but the trifling degree of pressure on the tumour, or of dilatation of the canal, that even a large one can produce, cannot be expected to effect long continued

benefit. By the dilator, on the other hand, which may be made to enlarge to any diameter, while it produces little irritation, the patient, if not completely cured, will at least be enabled to live with much greater comfort than when depending solely upon the catheter.*

3. In urinary calculus.

In the early stage of this complaint in men, and in later stages in women, for the purpose of dilating the urethra that the stone may be extracted, the dilator, from its strength of distension, and from being so much under our control, would appear preferable to the sponge tent, or to any other means.

"Stones of considerable size are often expelled by the mere efforts of nature, especially from the female

* [It was my intention to extend considerably the notice of the use of the dilator in diseases of the rectum and prostate gland, to which it is so obviously applicable, and in both of which I have employed it with very great advantage. But as the work has already attained a volume beyond the designed limits, and as the application of the dilator to be next mentioned will require particular attention, as coming more within the object of this republication, I shall defer my observations on its use in these diseases, as well as in others enumerated in the first edition. The extract on urinary calculus, which follows in continuation of the next paragraph, is taken from my Essay on the different modes of extracting stone from the bladder, which was published in 1821.]

bladder, the urethra in females being short, and not surrounded at its commencement, as in males, by the more unyielding prostate gland. In imitation of this natural cure, the female urethra has been repeatedly dilated by instruments with success; but for the safe and extensive dilatation of the male urethra no perfect means was until lately known. In attempting this, the object has been either to dilate the whole of the urethra, or only the part near the bladder, beyond an opening made into it from the perinæum. In the former way it is recorded, that the older Arabian Surgeons extracted stones, the passage being simply inflated, or widened by inflating with the mouth a distensible canula introduced into it, upon which the stone, after being put into the further extremity of the canal by the finger in the rectum, was drawn through by suction.* These accounts, however, have in Europe been totally discredited, although circumstances, to be presently mentioned, will render it probable, that absurd as some of the recorded particulars of the operation evidently are, there was really some method in use for extracting stones by mere dilatation.—The whole urethra has likewise been dilated for this purpose

* Alpinus "De Medicina Ægyptiorum," vol. iii. p. 14.

by a succession of bougies.* One principal objection to dilating the whole urethra is, that the length and curve of the canal prevent the easy introduction of a forceps to extract the stone; and, as opening the urethra from the perinæum is attended with no danger, this has generally formed a preliminary step to dilatation. In the operation called lithotomy by the apparatus major, which was the common cure of stone for several centuries, the dilatation was made by introducing through this opening, into the bladder, a dilator of steel blades, which were expanded forcibly to the required extent. This method was, in every instance, exceedingly painful, and the mortality from it was very great, in consequence of the violence done to the parts. Even amongst those who survived the immediate effects of this violence, many were rendered miserable, during the remainder of their lives, by incurable fistulæ and incontinence of urine.

The lateral operation, which took place of that by the apparatus major, differs from it, chiefly in the circumstance that, in the former, the prostate gland and adjoining part of the urethra are divided by a knife, instead of being forcibly dilated or torn,

* Le Dran's "Consultations," by Reid, p. 163.

as in the latter. By it, therefore, the dangers from the peculiar violence done to these parts are, to a great extent, avoided; and although new dangers arise, they have been found less important than those from the sudden dilatation.*

In the Case, a detail of which follows, a new means was employed to dilate the entrance to the bladder, not liable to the objections made to all the expedients formerly used. It was a dilator filled with air, such as is represented in the Plate, *fig.* 3, introduced by an opening in the perinæum, which opening, by the time of the operation, had become callous. Dilatation, by such means, constitutes an operation for the removal certainly of small stones, and probably those of larger dimensions, safer and less painful than any which had been yet practised.

CASE.

A Gentleman, beyond middle age, had been operated upon in the usual manner for stone in the

* The lateral operation, however, as performed by many surgeons, is a very near approximation to that by the apparatus major. Bromfield, in the greater number of cases, cut only the fore part of the prostate gland, leaving the base to be dilated or torn, a practice which, he informs us, was never followed by urinary fistula.

bladder. Owing to the extreme fragility of one of several stones that existed, it broke in the extraction, and it was not until after three successive searchings, with an interval of about a week between each, that the bladder was supposed to be cleared of the fragments. Another unfortunate circumstance happened in the operation, which was, that the rectum was wounded. The wound of the rectum had continued in a fistulous state ever since, being a period of nine months, fæces occasionally passing by the urethra, and urine by the rectum. Some weeks after the operation, a severe irritation of the bladder arose, and the urine was sometimes expelled by painful spasmodic contractions of the bladder, at other times it dribbled involuntarily off by the fistulous opening. Various expedients were resorted to for the cure of the fistula, but in vain; and in this state, he came to London, where he was under the joint care of Mr. Astley Cooper and Dr. Arnott. With a view to the cure of the fistulous communication between the urethra and rectum, Mr. Cooper made an opening into the urethra, from the perinæum, close to the commencement of the fistula, and by this opening he introduced a female catheter into the bladder, which remaining in the bladder, and preventing its painful contractions, soon materially allayed the ir-

ritation. Upon then sounding the bladder, a stone was discovered; and, as it was likely to be small, but a short time having elapsed since lithotomy had been performed, Mr. Cooper was willing to try the effect of the new dilator, in opening the passage for its removal. Two of these instruments were accordingly constructed for the purpose, under my direction. The distensible tube in both was about six inches in length; the diameter in one, somewhat more than half an inch, in the other nearly three fourths: and the distensible tube was tied upon a silver canula, with both ends open, for the free exit of the urine. The smaller dilator being introduced in place of the female catheter, it was inflated as far as the patient's feelings would permit; and, as the sense of distension abated, I injected more air, generally after intervals of two hours. The larger instrument was substituted for the first, about twenty hours after its introduction, and eight hours after it had been dilated to its full extent. The passage was dilated to the size of the larger dilator in about six hours, and this instrument remained in the part till the forceps was introduced. During the dilatation, the patient had an uneasy feeling of distension, but not amounting to what is usually termed pain: he was feverish, and his sleep, at night, was fre-

quently interrupted ; but these circumstances may be as justly attributed to the anxiety he felt about the issue of a new operation on his own person, as to the irritation from the distention. The urine flowed constantly through the open tube.

In extracting the stone, Mr. Cooper employed the common forceps ; and, in all respects, except that there was no director used in its introduction, as in the usual lateral operation. The stone was a flattened oval, and of about the size of a walnut.*

Two or three hours after the extraction of the stone, the bladder contracted, and expelled, chiefly through the opening in the perinæum, about six ounces of urine. Some spasmodic pain accompanied the contraction ; and, as he had formerly experienced so much relief from the introduction of the short catheter, he expressed a wish that it might be reinserted, and the water let off by it till the irritation of the bladder had completely subsided. In four days this had taken place, and the patient now left his bed-chamber. On the ninth day after the operation, the wound in the perinæum was completely healed, and he was able to take exercise abroad.

* Fig. 4. in the Plate.

In this operation, an opening into the bladder of considerable size was produced by dilatation, without the pain that accompanies lithotomy, or its danger. The difference between this *gradual, easy* dilatation, as produced in the above case, and the *violent, painful* dilatation which used to be effected by the apparatus major, and still is in the common lateral operation, when the gland has been but slightly cut, is sufficiently manifest; it bears a greater resemblance to the dilatation of the female urethra, which has been effected by gentian-root, sponge tent, and the gut filled with water, which was once employed by Bromfield; and of the male urethra, by the Arabian mode adverted to. But the root, sponge, or gut could not, it is probable, exert sufficient power to open the prostate gland; neither is the pressure of the two former properly under control; their passage to and fro would excite irritation; and the gut expanding from the heat and moisture, to an uncertain extent, would render it impossible to ascertain the degree of dilatation made. Of the Arabian mode of inflation, we know too little, to speak of its comparative merits.

It is impossible to form an idea to what extent such gradual dilatation may be carried without injury; but, should the operation be found well adapted for

the extraction of stones of a moderate size, patients aware of this, and undeterred by the nature of the cure, would apply for relief in the early stage of the disease, so as to render the adoption of hazardous and more painful measures unnecessary. By attention to several circumstances, we can in general form a tolerably correct idea whether the stone be of small size: but should it happen, in any case, that the dilatation could not be carried to the sufficient extent, the stone may be broken or otherwise reduced in size."

[Before proceeding to the further consideration of the proposed method of removing stones by dilatation, I will advert briefly to the improvements which, of late years, have been made in this interesting department of surgery.

At the date of the publication of the Essay from which the above extract is taken, it was supposed that the only progress of which the surgical treatment of urinary calculus was susceptible, must proceed from improvements in the operation of lithotomy; and the medical world were engaged at the time in disquisitions respecting the propriety of

reviving the high operation, and the value of a mode then recently proposed of extracting stone by an incision from the rectum. There had been, indeed, exceptions to this opinion; there had been projects at different times, and in different countries, to remove stone without lithotomy, as those of M. Gruithuisen of Bavaria, MM. Percy and Civiale of France, and Mr. Elderton of England, and in the succession in which their authors have been named; but being mere speculations, they had failed in attracting public attention to the subject, or in leading to any improvement in practice.

The operation of which the history has been given above, was the first well authenticated instance in modern times of the extraction of a stone of considerable magnitude from the bladder of the male without having recourse to lithotomy; and this alone, independently of the other proposals of improvements in the treatment of calculus which accompanied its publication, was, therefore, eminently calculated vividly to excite the attention of Surgeons, and afford ground for the hope that the most dreaded of surgical operations would at length be superseded by a safer and less painful method of cure. This hope has not been disappointed: by the continued investigation of the subject from the

date of that operation to the present time, improvements so considerable have been made as to have procured for their result the eulogium of being "the greatest triumph of the art of Surgery;" and it is probable that they will still advance until every reasonable wish or expectation respecting a remedy for stone shall be speedily fulfilled.*

In little more than a year after this operation, (November 1820) Sir Astley Cooper, who had been engaged in performing it, applied again the principle of dilatation in the extraction of calculi from the bladder of another male patient, but

* The assertion that this was the first well authenticated instance of removal of stone from the male without lithotomy, requires explanation with reference to the operations which Col. Martin, of the East India Company's service, performed on himself, about 60 years ago. That he must have considerably reduced the size of the stone in his bladder by applying a file to it three times a day for six successive months, cannot be questioned; but from the accounts of the illness which preceded his death, it is doubtful whether he succeeded in completely removing it. What he did accomplish, from not being duly authenticated, failed in producing that beneficial effect which it was so well calculated to do, in stimulating the ingenuity of surgeons to perfect such an operation—to complete what he had so happily commenced. "When I mentioned the fact to Mr. Pott" (says the celebrated Warren Hastings in a letter on the subject to Sir John Sinclair) "he evidently showed by his looks and silence that he did not believe it." See London Medical and Physical Journal, Vol. I.

by a different mode from that which had been suggested in my first publication, and originally employed. He at first endeavoured to effect the necessary degree of dilatation by introducing a succession of large bougies at intervals of two or three days, but failing in this attempt, he substituted the instrument alluded to at page 89, which answered the purpose both of a dilator and forceps. Like the bougie, it dilated on the principle of the wedge, but as this dilatation took place during its extraction from the bladder, and with the point of the wedge directed towards the orifice of the urethra, quick dilatation to a moderate extent could be more easily and safely accomplished by it than by the use of the bougie. This operation was successfully repeated by the same eminent Surgeon, by Sir Benjamin Brodie, and others.

Although I was enabled, by operating for calculus in the female, to confirm the opinion I entertained that the fluid dilator was much better adapted, by its equable and continued action, for the production of extensive dilatation, either of the whole urethra as originally proposed, or only its posterior position, than the metallic instrument which had been substituted for it, the opportunity I anxiously desired of repeating the original operation,

I was not so fortunate as to obtain before leaving England.

We shall now advert to the similar inquiries which originated soon after these operations, in the neighbouring country of France.

As an account of Sir Astley Cooper's operations by the dilating forceps appeared early in 1821, in volume XI. of the Medico-Chirurgical Transactions, the high character of that work, and the celebrity of the author of the account, would naturally attract the attention of Surgeons on the continent to this unquestionable evidence of the possibility of extracting stone without having recourse to the operation of lithotomy. There is proof at least of one French Surgeon being acquainted with the success of the operation by dilatation, whose name will be again mentioned in connection with these improvements, namely, M. Ducamp. His reference to my second publication, shows that he had the tract containing an account of this operation, and of various other suggested improvements in the treatment of urinary calculus, in his possession before the publication of his work on strictures ; but that he was, at a much earlier period, acquainted with the operation, which was the most important circumstance, will appear from the following statement. In the

Number of the London Medico-Chirurgical Review for October 1819, M. Ducamp's name will be found in the list of subscribers to that Journal, and in a review, in the same Number, of my work on strictures, there are inserted some particulars of the operation, with the following prefatory remarks: "We understand that at the last sitting of the Medico-Chirurgical Society, Mr. Astley Cooper spoke in high terms of Mr. Arnott's dilator, and alluded to a case where the instrument had superseded the use of the gorget or scalpel, in the removal of a stone from the bladder."

In May, 1822, at meetings of the Academies of Sciences and of Medicine in Paris, three papers were read relating to improvements in the treatment of the diseases of the urinary organs by three young Surgeons of Paris. One of these papers, was MM. Deschamp's, and Percy's report on M. Ducamp's MS. treatise on Strictures; the two others were proposals by MM. Le Roy and Amussat of methods for extracting calculus from the bladder without lithotomy.

In March, 1824, M. Civiale succeeded in removing a stone from the bladder by a method similar in principle to that which had been proposed by

M. Le Roy, and to M. Le Roy therefore the priority of the invention has generally been conceded.*

* "M. Le Roy d'Etiolle, déja connu de l'académie comme le principal inventeur des instrumens lithotriteurs."—Report of a Commission of the Academy of Sciences, 1828.

The only account I have been able to find of M. Le Roy's proposed instrument is contained in a note inserted in a French Medical Journal, the "Revue Medicale" for 1822. After a description of the principal part of M. Le Roy's apparatus called a *Lithoprione*, which consisted of a small circular or trephine saw ("petite couronne de trepan") for piercing the stone, and which he proposed to introduce through a tube, the account proceeds thus: "L'instrument de Le Roy pourrait fournir les moyens de mettre à profit les decouvertes de la chimie moderne. Parmi les reactifs capable de dissoudre les pierres, il en est qui peuvent être introduits dans la vessie sans danger; mais ignorant à quel espace de calcul on a affaire, on pourrait augmenter son volume au lieu de le dissoudre; ce lithoprione en faisant connaitre la nature intime de la pierre, permettrait de choisir à coup sur le reactif capable de la detruire." At page 7 of my tract on calculus when treating of the solution of stone by injection, previously to the suggestion of a means of keeping up a constant stream of a very weak solvent, and after stating the difficulty that had been experienced in ascertaining the particular species of calculus in order that the appropriate solvent, might be applied, there occurs the following paragraph. "Now if the smallest particle of the stone could be procured, its chemical composition may with certainty be determined. With this view the following means may be adopted: When the stone comes to the orifice of the bladder, let an open-pointed catheter (having of course a ball-ended wire filling it during the introduction) be passed till it touch it, and by this a small circular saw, like that of the trephine, may then be introduced to grate off from the calculus, by a few turns, a sufficient quantity of dust for examination."

Actuated apparently by a desire to prove the correctness of an assertion he had made, and which is referred to in his correspondence with Baron Percy on the subject of the priority of the invention, that he had found the idea of his instrument in the older writers on Surgery, ("instrument, dont l'idée suggerée par l'ancienne chirurgerie") M. Le Roy published, in 1825, an erudite work on the several propositions or attempts that had been made to extract urinary calculus without having recourse to lithotomy. A recent perusal of this work solved a mystery which had long perplexed me. As M. Ducamp had made such good use of most of my new propositions respecting the treatment of strictures, it seemed extraordinary that none of those on the subject of extracting stone which were contained in the same work had attracted his attention, or had been adopted and modified by him. I was mistaken: for it appears by a passage in M. Le Roy's book, that M. Ducamp had not only been occupied with the subject, but that he had assisted in the invention of M. Le Roy; and soon afterwards I found a statement to the same effect in a memoir annexed to the second edition of M. Ducamp's book on strictures.

"Un medicin (says M. Le Roy) qui sut se rendre

célebre dès les premiers pas dans la carrière, Ducamp, qui eût tant fait pour la science s'il eut vecu, me fit sentir cet inconvenient, et me conseilla de substituer à ce moyen un archet, &c."*

And the writer of the memoir informs us that "Ses recherches sur les voies urinaires lui avaient donné l'idée d'un instrument destiné à détruire la pierre dans la vessie, sans recourir à l'opération de la taille. Il avait aussi confié ses idées, sur ce nouveau travail, à l'amitié éclairée du pharmacien qui avait applaudi aux premiers essais de son traitement des rétentions d'urine. L'instrument qu'il a terminé n'avait point atteint le degré de perfection auquel il fût parvenu sans doute, si Ducamp eût eu le temps d'y faire les améliorations que l'expérience lui eût indiquées; mais, tel qu'il est, cet instrument peut être considéré comme un grand pas fait vers le but que Ducamp voulait atteindre. Maintenant que les premières et les principales difficultés sont surmontées, il n'y a pas de doute qu'on parviendra à perfectionner son invention et à épargner aux malades attaqués de la pierre une opération aussi cruelle que perilleuse. Lorsque ce but si désirable sera atteint, la gloire ne lui en sera point étrangére, et l'humanité devra un nouveau

* Exposé des divers procédés pour guerir de la Pierre sans avoir recours à l'opération de la Taille, par J. Le Roy, M. D. 1825.

tribut de reconnaissance à sa mémoire." In another work by the same writer published two years afterwards the same subject is referred to as follows: "Ces ébauches ont servi dans la suite à composer celui de M. Leroy et dont M. Civiale a su profiter plus adroitement. Néanmoins on pourrait reprocher à M. Civiale de s'être peu inquiété de l'inconvenient de multiplier les pierres de la vessie, sollicitude qui avoit d'abord retenu Ducamp, qui eût probablement complété son brise-pierre s'il ne se fût pas arreté à créer une poche dans laquelle il désirait retenir les fragments, pour les dissoudre ou les extraire plus faciliment par des injections."

It is curious to trace in these observations the influence under which M. Ducamp's researches were conducted. An objection was made in my tract on the subject, to lithotrity as compared with the solution of stone, or its extraction by dilatation, principally because its first effect would be to "increase the number of stones;" and the attention of Surgeons was particularly directed to the practicability of enclosing the stone in a bag in order to facilitate its solution.

Now, considering that my Essay on calculus, which was in the hands of M. Le Roy's associate and adviser, M. Ducamp, contained the ideas of the es-

sential parts of his apparatus, viz, those of a circular saw acting through a tube, and of springs not merely to enclose the stone, but to open a bag in which it may be placed for solution,—and (what was of much more importance) that it contained the details of an operation by which a large calculus had at last actually been removed from the bladder without lithotomy—considering that these were the contents of the Essay, it is rather extraordinary that no mention is made of it in the work of M. Le Roy, which professes to give a reference to every thing that had been written on the same subject from the earliest records down to the date of its own publication, in 1825.—But enough has been said to enable the reader to judge whether the researches on the means of extracting stone from the bladder without lithotomy originated in France as independently as has been asserted and generally believed.

In my Essay on calculus, lithotrity or the diminution of the size of stones by mechanical means, was (as appears by the concluding sentence of the extract) contemplated not as the main object, but only as an auxiliary to dilatation; and I am still of the same opinion. The irritation produced by a series of

lithotritic operations, and by the fragments remaining in the bladder until the whole of these operations be completed, is a serious objection to lithotrity, as having caused a considerable mortality notwithstanding that the cases in which it has been performed have been selected. The danger from such irritation will be reduced almost in proportion to the size to which the urethra has been gradually enlarged, inasmuch as the use of the necessary instruments will be thus facilitated, and the fragments of the calculus more easily expelled or extracted.*

* "The average mortality from lithotomy in all hands appears at present to be about one in eight; and when it is considered that children of all ages, among whom the operation is almost always favourable in its issue, are included in this reckoning, it is evident that among grown men the operation is very formidable and very fatal. Lithotrity cannot boast of anything even like this very moderate general success."—On Urinary Diseases and their Treatment, by Robert Willis, M. D. 1838.

The Edinburgh Medical and Surgical Journal for October 1838 contains a paper on lithotrity by Mr. Fergusson, professor of surgery in King's College, London,—in which are stated the following results of operations of lithotrity, with the circumstances of which he happened to be well acquainted. "Out of eighteen cases six have been cured, seven not cured, and five have died. Indeed in two of these cases only can the operation be said to have been attended with that happy success which has been so generally claimed for lithotrity." * * * "Of the eighteen cases eight were operated upon by a lithotritist of great reputation, three only of which were cured, and many of the others were treated by hands of acknowledged dexterity." Notwithstanding

Several propositions of slowly dilating the posterior part of the urethra after opening it from the perinæum, have been made since the publication of my Essay.

The first of these which I shall mention was made about ten years ago by Dr. Buchanan, Surgeon to the Glasgow Hospital. As his communication on the subject differs in nothing from the sub-

these results, so different from the accounts of the professed lithotritists, this writer admits that lithotrity is a "brilliant addition to the art of surgery," although applicable to a much smaller number of cases than has been asserted by its principal advocates.

Lithotrity, however, may probably yet be improved, independently of making it subservient to dilatation. The fatal irritation which is caused by searching for small stones or fragments, might perhaps be prevented by injecting the bladder with mercury as well as with water, that they may float on its heavier surface and thus be more easily detected and seized by the lithotriptor.

M. Civiale, the dexterous lithotritist, in his publication of 1823, recommends as the first step in the operation that the urethra should be dilated by fluid pressure. "Pour dilater l'uretre d'une manière prompte, efficace, et peu douleureuse, il faut employer un dilatateur facile à introduire, et dont l'action s'exerce ainsi que nous l'avous déjà dit, dans le sens de l'extensibilité du canal de dedans en dehors. Nous employons avec assez d'avantage un cylindre de boyau de chat préparé, &c. As he seems to have adopted M. Ducamp's opinion, expressed in his book on strictures, published the year before, that there is no necessity for silk or other resisting material in the membranous tube of the fluid dilator, he must have found such means quite inadequate; and on this account, probably, he appears to have abandoned the idea of preliminary dilatation.

stance of the above extract, excepting that he recommends that the dilatation should be made by a steel instrument of several blades expanded by a screw, it requires no further notice. His claim to originality in the proposal of slow and continued dilatation was disputed by Mr. Keate of St. George's Hospital, in a letter inserted in the London Medical Gazette for December 25, 1830, in which he states that he had, "seven or eight years before," made several operations upon the dead subject, of the kind proposed by Dr. Buchanan. He did not, however, deem it proper to recommend this plan as a substitute for lithotomy, on account of the necessary protraction of the operation, the comparative safety of lithotomy under favourable circumstances, and the supposed inapplicability of the operation by dilatation to cases in which lithotomy cannot be employed. Although speed in an operation is desirable when the patient's safety is secured by it, or his suffering is lessened, such reasons do not exist in the present instance, where danger and pain, instead of being caused, are prevented by prolonging the process of dilatation; that is, if proper means be used for effecting it, which, however, steel dilators, from the very unequal nature of their pressure, are far from being. It will not be necessary, after pre-

ceding observations, to inquire whether or not a substitute be desirable for lithotomy, an operation attended with much pain and danger under whatever circumstances it may be performed.

In the "Journal Medical de la Gironde," Vol. V. p. 133, for March 1826, there is a similar proposal, which was lately pointed out to me by a friend conversant in the modern medical literature of Europe. It was made by M. Guerin, an eminent Surgeon at Bordeaux, and celebrated for his skill in lithotomy. He relates, that being himself attacked with symptoms of stone, he began to study whether a safer and less painful mode of relief might not be substituted for lithotomy; and came to the conclusion, that the further part of the urethra might be gradually opened to a great extent by means of the swelling from moisture of a root prepared for the purpose, inserted into it from the perinæum, and that the stone might then be broken and extracted piecemeal if too large for removal in its entire state.*

* "Les nombreux succès qu'on obtient à Bordeaux dans l'operation de la taille, depuis plus de trente ans qu'on y opere exclusivement par mes procédés, ne me laissaient plus de doute sur la certitude d'avoir atteint le plus haut degré de perfection auquel l'art pouvait arriver, lorsqu'un événement, qui m'interressait particulièrement, me faisant examiner les choses de plus près

The desideratum for the due performance of this operation has probably been, not a proper indication or intention, but proper instruments for fulfilling this. The plans which we have just alluded to, would probably, on this account, fail in dilating the parts sufficiently for the extraction of a large stone. It can scarcely be conceived that the ancient operators by the apparatus major, while they professed to take the process of parturition as their model, should have persisted for two centuries in their barbarous method of cure, tearing open the urethra in the shortest possible time, and even priding themselves on the rapidity with which this could be done, had they been furnished with adequate means of producing slow dilatation. But instead of parturition, a safer and better model for such an operation would have been the slow dilatation of the urethra which nature occasionally effects

me les fit voir d'un autre œil et sous d'autres rapports. Menacé moi-même en effet, d'être atteint de la pierre, &c."

He concludes an apology for publishing the proposal before having proof of its success (although analogous facts, he says, are equally authoritative) in these words * * * "Je me hate de le faire connaitre, afin qu'on en faisse l'épreuve, pour jouir dans mes derniers jours, si je ne suis pas trompé dans mon espoir, de la satisfaction d'avoir rendu enfin l'opération la plus difficile, la plus dangereuse, et la plus cruelle, l'opération la plus facile, la plus sure, et la moins douloureuse possible."

in relieving the urinary organs of stone ; or the slow dilatation (by equable fluid pressure) of other parts of the body, as the ureters, kidneys, intestines, and blood-vessels in consequence of disease. In attempting quick dilatation the most distensible of the animal structures will be torn, whereas if the process be slow, it may be carried to an enormous extent without breach of substance. An artery has been found dilated to a diameter of five inches, and yet all its coats have remained entire. Experience will determine the average period required in the proposed operation for opening the urethra, either entirely or in part, to the due extent. This will depend very much on the age and constitution of the patient, as well as other circumstances ; but that the dilatation should be made without injurious irritation, or great uneasiness from the feeling of distension, whatever time may be required, would be an indispensable condition. It may either be continued, or intermittent in imitation of the similar operations of nature. Even in disease of the prostate gland, a condition unfavourable to every other mode of relief, such equable and moderate pressure by a fluid would not probably be injurious. The prostate gland in its natural state, as formerly observed, does not always completely surround the urethra, and when

it does, the canal passes nearer its upper than its under surface. It has generally been supposed that its structure is of an unyielding nature, yet in the experiments of Le Dran, in illustration of the Marian operation, the prostate was often found entire where the urethra had completely given way from the sudden distension.

Although it might be preferable in some instances to dilate the whole urethra and extract the stone by Hunter's forceps, or break it by the screw-wrench lithotriptor, there cannot be any objection to opening the canal from the perinæum arising from the difficulty of the proceeding, or its unpleasant consequences. The incision is of small extent, and as free from danger as the incision by the lancet in bleeding; and as a staff is previously introduced, the difficulty that has occasionally occurred in opening the urethra in cases of retention of urine or impermeable stricture, cannot be experienced. Were a small vessel cut, the dilator would itself be the best possible means of compression, and very superior to anything that has been employed for a similar purpose in the operation of lithotomy. The dilatation might either be commenced immediately, or be delayed, as in the case related, until the opening in the perinæum be callous.

4. *In Obstetric Surgery.*

Labour is often prolonged, and with serious consequences both to the mother and child, by the morbid resistance of the parts to the passage of the child, or a resistance disproportionate to the expulsive powers. Various measures have been employed to remedy this condition; but these are often found inadequate, and their use is not unaccompanied with danger. Nature opens the passages, at least in great part, by mechanical means—by the soft wedge, as it has been called, of the distended membranes; and when these have been prematurely broken, either by natural causes or improper interference, much disorder in the process is frequently the result. The obvious indication under these and similar circumstances, is to use mechanical dilatation, and such, amongst other remedies for this state, has been the practice; but the means of dilatation employed, which has been no other than the hand or fingers of the practitioner, is so imperfect, that as much harm, probably, as benefit has proceeded from it; and as in former times this expedient was employed almost in every instance, and consequently in cases requiring no aid from art, such abuse and its evil ef-

fects have brought the remedy into discredit, and created a prejudice against the use of any means of this description. "Let not the principle suffer (says an eminent writer, when recommending mechanical dilatation in these cases) from its abuse, else where is the plan which would stand its ground."*

The fluid dilator may be advantageously used in place of the means alluded to. If Nature is to guide us in our efforts to cure disease, we cannot more closely imitate her operations than, as in the present instance, by substituting a membrane distended with fluid for the natural membrane which is wanting. But it is not my intention, on the present occasion, to enter into any disquisition on this subject, or description of apparatus. I shall only express my conviction, from much observation and reflection on the subject, that obstetric surgery will receive a valuable acquisition in the application of this principle of dilatation by fluid pressure, in cases, where, to prevent danger or suffering, not only in child-birth, but in the earlier stages of pregnancy, it may be advisable to open the passages with the least possible irritation. The construction of the apparatus may, on ordinary occasions, be exceedingly simple; and for using it, the best rule

* Burn's Midwifery, 5th Edition, p. 401.

will be to imitate as closely as possible the intermitting and gradual natural process of dilatation in parturition.

On the applicaton of Fluid Pressure to the Surface of the Body.

Although this subject has no connection with the applications of the new instrument for dilatation, yet as an illustration of the advantages of pressure being equable and controllable—the chief characteristics of the pressure exerted by the dilator—as well as on account of its own importance, it may be allowable briefly to advert to it.

Pressure applied to the surface by bandages, is the principal remedial means in a great many diseases, as chronic inflammations, glandular swellings, diseases of the joints, ulcers, dropsies of various kinds, &c; and operates by supporting the weakened vessels, promoting absorption, and otherwise influencing the vitality of the diseased structure. But to many parts of the body bandages are applied with so much difficulty as to be a serious impediment to their use; with every care, equable pressure

can scarcely be made or maintained by them, and from the difficulty of increasing or diminishing the pressure, which is consequently rarely done in the intervals of the Surgeon's visits, much suffering or mischief often arises.

For the bandage, the equable pressure of elastic air may be substituted with great advantage, by enclosing the part to be subjected to it in a close *double* case of india rubber cloth, of rather larger dimensions than the part, in order that, upon being inflated, a thin stratum of compressed air may surround it. The outer side of this case, or wherever it is not supported by the surface of the body, must be of strong material to resist the requisite degree of pressure, but the side in contact with the skin should be thin, and of larger dimensions than the other, for the purpose of its coming closely in contact with all the inequalities of the surface.

This case, or air bandage, may have its edges kept in contact by buckles or other convenient means; a double stocking, or long glove may be substituted in affections of the extremities. The inflation can be made by a syringe, or by the contrivance used for filling air beds and pillows.

Pressure by condensed air has already been employed in a few of the affections above enumera-

ted, but so imperfectly, from its being greater at the margin than elsewhere, and thus forming a sort of ligature, as to counterbalance its advantages, or even to be positively injurious. The mode now proposed, enables us to apply a perfectly equable pressure to the most irregular surface, and to moderate or increase it with ease, as the sensations of the patient or other circumstances may require. Should frequent intermissions in pressure be advantageous, they can thus also be easily obtained. By the substitution of such means for the bandage, pressure may not only prove more advantageous in cases where it has already been in use, but be extended to other analogous affections, in which, on account of the imperfect means of application, it has not hitherto been employed.

EXPLANATION

OF

THE PLATES.

Plate I.

Fig. I.—*An Instrument for ascertaining the Sizes of Bougies, &c.*

It consists of two straight jaws in contact at one end, and separated at the other, where No. 20 is seen, to the distance of half an inch. The length of the jaws is divided into twenty equal parts, numbered from the junction; and it is evident, that the distance between the corresponding marks upon the two jaws, as measured by any body that fills up the space between them, a bougie for instance, increases a 40th of an inch with each division; thus by observing at what part of the gap the bougie is arrested, on moving it towards the joining, we see its diameter marked in 40ths of an inch, and the number so found, designates its size. In the outline I have only marked every second number, to prevent confusion, and portions of bougies are represented filling up

the different situations in the scale, by familiarizing his eye with which, the Surgeon will soon be able to judge pretty accurately of the sizes without the scale.

Fig. 2. Illustrates the manner of taking the exact impression of the anterior surface and opening of a stricture, by a very soft ended bougie passed through a canula. The point of the bougie, altered by a stricture, is seen projecting from the canula (p. 71.)

Fig. 3. Is a copy of a figure in M. Ducamp's book, representing the impression made by a stricture on the point of a soft bougie, called by him "sonde exploratrice" (p. 71.)

Fig. 4. Is a part of the dilator sound (p. 154.)

Fig. 5. 6. and 7. The apparatus for the new method of applying caustic (p. 158) represented as applicable to a wide stricture, that the different parts may be the more conspicuous. Fig. 5. shows the canula which is to be introduced close to the stricture, and the caustic is seen issuing from it, preceded by the guiding piece of bougie. Fig. 6. shows the bit of caustic upon the wire, between the

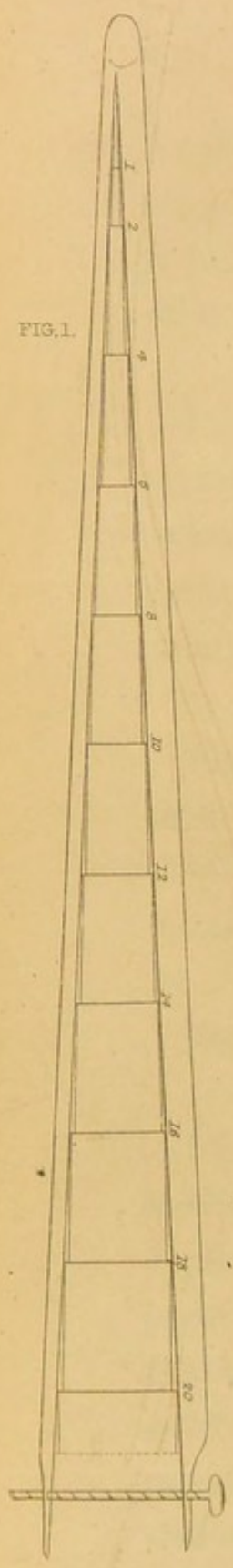


FIG. 1.

FIG. 2.

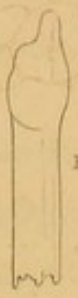


FIG. 3.

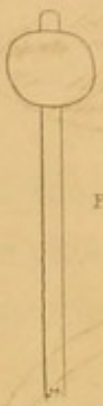


FIG. 4.

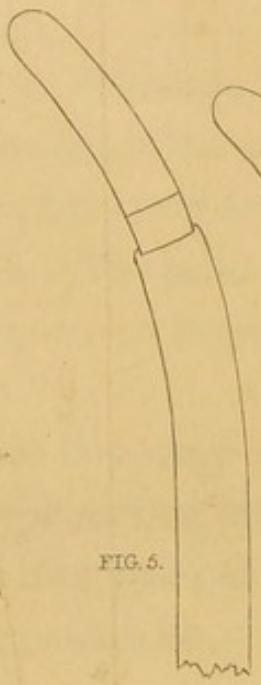


FIG. 5.

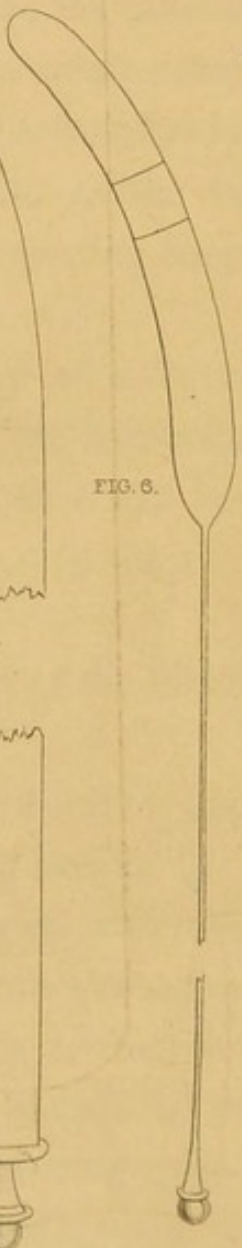


FIG. 6.

FIG. 7.

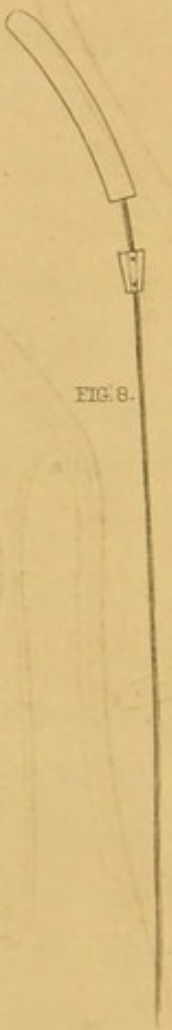


FIG. 8.

FIG. 1.

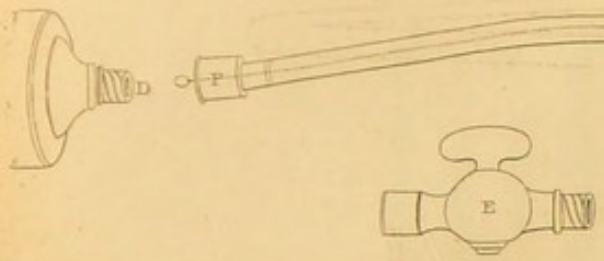


FIG. 2.

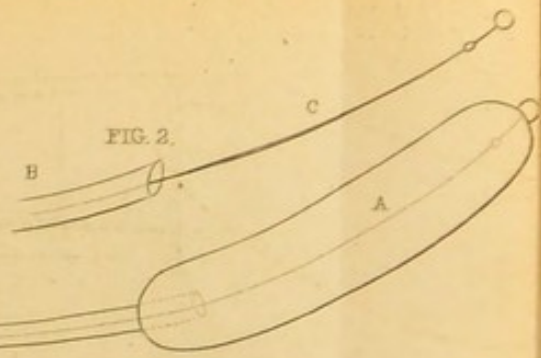


FIG. 3.

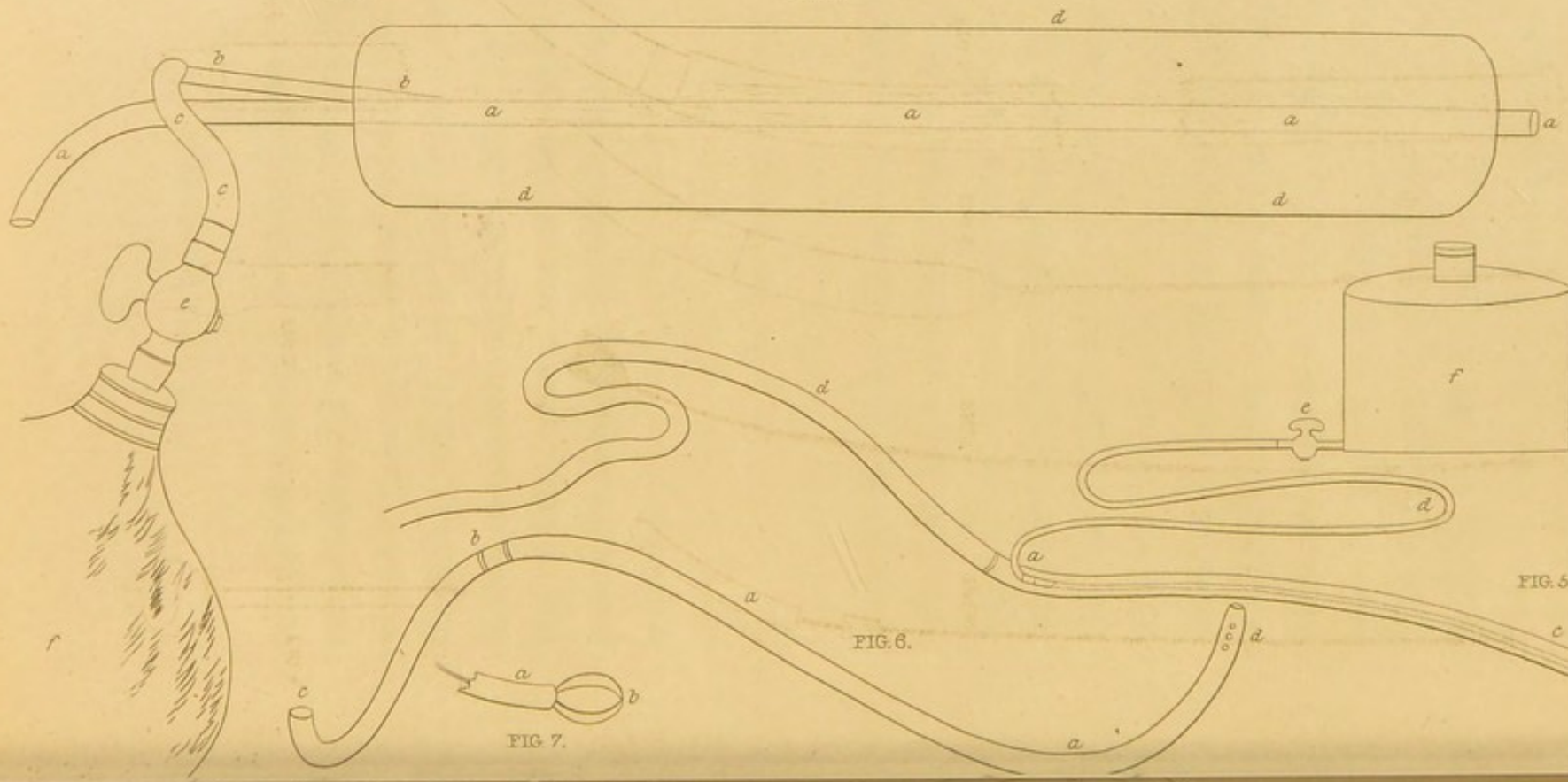


FIG. 4.

FIG. 5.

FIG. 7.

two pieces of bougie, as it is prepared previous to introduction. I generally put the caustic upon the wire, by making the latter red-hot, and passing it through. Fig. 7. is a wire with a hemispherical button at one end, to fill the end of the canula during its introduction, and at the other, a dossil of cotton, for absorbing the superfluous moisture at the stricture.

[It is convenient to have the caustic in the form of smooth beads of various sizes, to be placed when required on the wire, and fixed to it by heat; and as a security against particles separating, the caustic may be inclosed by a bit of the smallest platina wire of a spiral form. Or a metallic bead can be substituted, consisting of a bit of fluted tube pierced with small holes, covered either entirely or in part with caustic.(Fig. 8.) The bead may be kept in its place by a piece of flexible tube passed over the wire. The conducting point of the instrument may be flexible, or of the same material as the wire, in order to resist the action of the caustic. The distance of the stricture from the orifice, and the depth to which the wire is to be passed, can be marked

by touching the heated wire with sealing wax, or by means of a little ball of caoutchouc sliding upon it. When it is desirable to apply caustic to other diseases of the urethra, the instrument may be used as follows: after passing the conducting tube to the further limit of the diseased part, the wire may either be protruded from it, or the tube may be drawn over the wire, so as just to bring the caustic in contact with the surface to be cauterized, when both are to be extracted together, (with a slowness proportioned to the intended severity of the application,) until the caustic shall have reached the anterior limit of the disease, when it must be drawn into the tube. In this method there is no occasion for the projecting guide. The modification, by Professor Lallemand, formerly described, also answers very well in such cases, when the part to be cauterized is situated where the groove containing the caustic can be easily turned round, so as to bring it in contact with the whole circumference.]

Plate II.

Fig. 1. Represents, in its distended state, a common urethra dilator of size No. 14 (p. 92.) The part

which acts upon the stricture is the short tube of strong silk, A, when distended. This is lined with thin gut, to make it air-tight, and covered with the same, or with varnish, to make it smooth for passing down. One end of it is tied upon the extremity of the directing wire C, and the other upon the extremity of the tube, or canula, B. The wire C, which runs through, and projects beyond the canula B, serves to conduct the dilating tube in its collapsed state into the stricture, and by the canula the distending fluid, air or water, is injected from the syringe D. The stop-cock E, screwed into the outer end of the canula, at F, retains this injected fluid.

Fig. 2. Represents the skeleton of part of the dilator, without the distensible tube, that its construction may be better understood.

The canula B, may be of the common elastic catheter tube, or of tin, which is flexible, or of silver. To its outer end at F, is fixed, by cement, a small connecting piece of brass, to receive the corresponding screw end of the stop-cock E, or of the syringe D, when only momentary distension is made, and the cock therefore is not required. At its other end (fig. 2,) it is represented as roughened, that the silk and gut tube may be more securely attached to it.

The wire C, A (which is represented by the dotted line in fig. 1,) is of silver, prepared so as to be elastic, as small as the necessary degree of strength will permit, and sufficiently long to project from both ends of the canula ; from the inner end as much as the length of the distensible tube is required to be, and about one-fourth of an inch at the outer end, where it has a knob on it, or hook (this hook must not be elastic) to prevent the possibility of its slipping from the tube, and being left in the urethra.

At its point (fig. 2,) there are two knobs or risings, between which the silk is tied on ; one constitutes the point of the finished instrument, and is one-tenth of an inch in thickness, that it may pass easily ; the other, a quarter of an inch distant from it, is merely large enough to prevent the tying from slipping back upon the wire. The wire is freely moveable to and fro in the conducting tube, for several reasons, such as to facilitate the tying on of the silk, so as not to leave it twisted, and that the silk tube be neither too slack nor too tight on the wire. That the Surgeon may be able, however, to direct the point of the wire to the opening of the stricture, the whole should receive the double or S curve, natural to the urethra, as is shown in the Plate.

In particular cases, instead of the wire, some

other substance, as whalebone, may be substituted with advantage, but the Surgeon must be aware of the possibility of a very flexible point being bent back on itself, or doubled in the canal, in which state, should the instrument be distended, considerable injury might ensue.

The syringe D is a brass forcing syringe, three and a half inches in length, and a full half-inch internal diameter. When it is meant to continue the distension for some time, the small brass stop-cock E, fig. 1, must be attached to the tube.

For ordinary cases of stricture, the distensible tube may be constructed of strong silk ribbon, with the edges sewed together, and having its seam turned inwards, lined and covered with thin gut. Such a tube will in every instance be found of sufficient strength to bear the requisite degree of pressure. The greatest pressure of the thumb upon the piston of such a syringe as has been described, will rarely rupture it, and this force is more than the hardest stricture can for a moment resist. When little bulk in the dilator is desirable, as in the very beginning of the treatment, the thinnest oiled silk, lined with a gut, will be preferable; but as this will often give way to great pressure, it is proper previously to ascertain how much it can resist, and to point this

out by a mark or check on the piston rod of the syringe. Besides the loss of the distensible tube from such an occurrence, there is a chance of injury to the urethra from the lining gut then protruding forcibly through the breach in the silk. In some very narrow strictures I have even used at first merely a bit of single or double gut without a covering of silk at all; but besides the want of strength, in such a tube, to bear any useful degree of pressure for hard strictures, it soon enlarges from the moisture, and is thus apt to distend the sound as well as the contracted parts of the canal. It is possible that some kinds of gut may be naturally, or by preparation, sufficiently strong to bear momentary useful pressure, yet this is not particularly desirable, for although such a tube might be simpler, it would not endure, by any means, so long as that of silk; and a silk tube dilator, of moderate diameter, when collapsed, is as small as the smallest point that can safely be introduced through a stricture. The dimensions of the silk tube will vary, of course, according to the circumstances of the case in which it is to be employed. If several strictures are to be dilated at the same time, and if they are situated in the curved part of the urethra, the distensible tube must be long, and corresponding to this curve; but, on ordinary occa-

sions, it should seldom exceed two inches in length, and then the curve is unnecessary. The regulations of the diameter of the dilator will be afterwards noticed.

The gut which I have preferred for these purposes is that of the cat. When prepared, by stripping off the outer fleshy coat and inner villous one, it is exceedingly thin, and yet sufficiently strong. That the gut may be completely supported by the silk tube when distended, it must be at least of equal dimensions with it; and it is well to ensure this by choosing it of a larger size. When the stricture will admit an instrument of considerable size, as in stricture of the rectum, in order to preserve the dilator long air-tight, the lining gut may be double. When the silk has a covering of gut, which, on several accounts, answers better than varnishing it, this outer gut must be pierced in several parts, in order that any of the fluid escaping from the inner gut may have free escape into the urethra, and not distend the covering beyond the silk.

The only part of the preparation of the dilator requiring nicety of execution, is the attachment of the distensible tube to the conducting tube and wire, which must be at once very neat and very secure. The silk tube and lining gut should be tied on to-

gether, the artist taking care that the wire be kept exactly in the axis of the tube, or that the wrinkles or folds at the extremity be equal all round. The tyings may be made conical by notching the extremity of the silk after two or three turns of the small strong waxed silk thread have been made round it, and by then continuing the thread completely over it. The tyings should then be smoothed by a coating of bougie wax, and if unvarnished silk has been used, the operation is completed by covering both the silk and the tyings with a bit of gut. The secure attachment of the distensible tube to the canula and wire is a matter of great importance; for, should the silk become detached in the canal beyond the stricture, it might happen that the combined action of the urethra and the flow of urine would not be able to expel it, until the stricture were fully dilated; it behoves, therefore, both the instrument-maker and the Surgeon, to be careful that there exist no such hazard. The accident would prove great negligence.

The gut must be wet during the preparation of the instrument, and at each time of using it, to prevent its cracking, or the escape of the air under the dry and shrivelled tyings. After use, the water must be as much extracted as possible, and then it

should be inflated and put aside to dry. This prevents the rotting of the gut. When the distensible tube consists of unvarnished silk lined and covered by gut, it is more easily both dried and moistened, than when varnished silk is used.

The only difficulty which Surgeons may experience in commencing the practice of the dilator, is to know when they have got the distensible tube exactly in the stricture. By careful previous measurement the object may in general be secured, but where there is doubt, the end of the conducting tube may be enlarged, so as to form a kind of button; and when this is obstructed in passing on by the stricture, the silk tube must be within it. Or again, a short distensible tube without such a button at its outer extremity, may be passed beyond the stricture, then filled and retracted till this impede it; allowing then the fluid to escape, and withdrawing the instrument half an inch farther, it will be within the stricture.

After these very minute directions, equally necessary to be attended to by the Surgeon and instrument-maker, I trust that the difficulty of preparing the dilator, and keeping it in order, will not henceforth annoy Surgeons in using it. Two or three sizes of the dilator are sufficient for the treatment of every common case of urethral stricture.

Fig. iii. is one of the Dilators used in the case detailed at p. 191, in which the stone, *fig.* iv. was extracted from the bladder, without cutting the prostate gland.

a, *a*, *a*, *a*, is a canula, by which the urine may run off.—*d*, *d*, *d*, the distensible tube of silk, lined with gut, surrounding the former.—*b*, *b*, *b*, the small canula, through which the distensible tube is inflated from the bag *f*; *e*, being a stopcock to retain the air after injected, and *c*, *c*, a bit of flexible tube connecting the cock to the air tube, so that touching the cock by the syringe or bag may not jar the dilator in the tender passage. A valve might be substituted for the cock with advantage. As it is important that this dilator should be perfectly air tight, to prevent the necessity of withdrawing it for any other purpose than the substitution of a larger as the dilatation goes on, the silk tube should be lined with double gut.

[In operating for stone in the female, I discovered that there is an advantage in using a large bag as a reservoir of air, which may be compressed between two wide disks, acted upon by a screw. A little water injected with the air keeps the gut moist, and although it oozes through this, the large

quantity of air in the dilator and reservoir together, makes the loss immaterial. Other substances impermeable to air, such as caoutchouc, may be substituted for the perishable gut; and a spring placed on the membranous tube would not only increase the pressure as explained at page 96, but by an adaptation for the purpose, might serve, on withdrawing the dilator, as a tube to facilitate the extraction of the stone. A spring from its equal pressure might, itself, answer better as a dilator in such cases, than any of the steel instruments that have been employed. Instead of the common stone forceps, a modification of Hunter's forceps may be used, as means of easy extraction only, and not of further dilatation, is required.]

Fig. v. is the Double Catheter, for injecting the bladder in cases of irritation of it, or contraction, and for the solution of stone: it is exhibited on a reduced scale.

f, is the reservoir of the liquid to be injected; *d*, the flexible tube, commencing at the stop-cock *e*, by which the liquid is conveyed to the inner catheter *a*, which then carries it into the bladder, opening at *a*; *b*, *b*, *b*, is the outer catheter, by which the

fluid returns with the urine, and is directed to a proper receptacle by the flexible tube *c*, of any desired length. It is important to have the outer catheter of considerable diameter, to diminish the chance of its being obstructed by tenacious mucus, so commonly secreted in disease of the bladder.

[This apparatus may be usefully employed in several of the diseases of the urinary organs. I employed it for the relief of irritable bladder in the year 1819, without being aware that it had been suggested by Hales a hundred years before, although it had never, I believe, been actually applied to surgery. Sir Benjamin Brodie has used the double catheter with great success in a case of urinary calculus. Instead of the reservoir, however, as represented in the Plate, by means of which it was intended that a current of very weak solvent should be kept up for a long period, he substituted an elastic gum bottle, by which he injected the bladder for twenty minutes to half an hour at a time, and at intervals of two, three, or four days. Further trials, I conceive, are required to prove whether solution by such means will form an advantageous substitute for other modes of extract-

ing stone. The experiments which I made with a double catheter on calculi out of the bladder, encouraged me to hope for the happiest results.

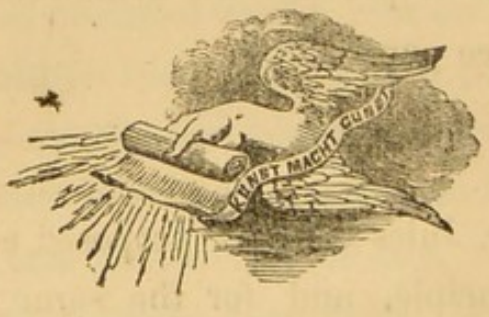
The use of this catheter may be yet extended. In hemorrhage from the bladder an uniform stream of cold water or astringent lotion would probably be the most effectual remedy. In the Lancet for September 29, 1838, there are two interesting cases of this affection related, in which the hemorrhage was suppressed, in one instance, by an injection containing tannin, in the other, by repeated injections of iced water. Hemorrhage from the womb or rectum might be checked in a similar manner.]

Fig. vi. the Syphon Catheter, for drawing off the urine constantly and completely after the operation of Lithotomy and puncturing, or any wound of the bladder, so as to prevent the urine escaping by the wound.—(See page 139.)

[Professor Jules Cloquet proposed a contrivance on this principle, and for the same purposes, in 1824.]

Fig. vii. is to give the idea of something made to protrude from the end of a catheter or tube, after its introduction into the bladder, which will act as a button to prevent the tube slipping out (p. 139.) A variety of contrivances are applicable to this purpose.

THE END.



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