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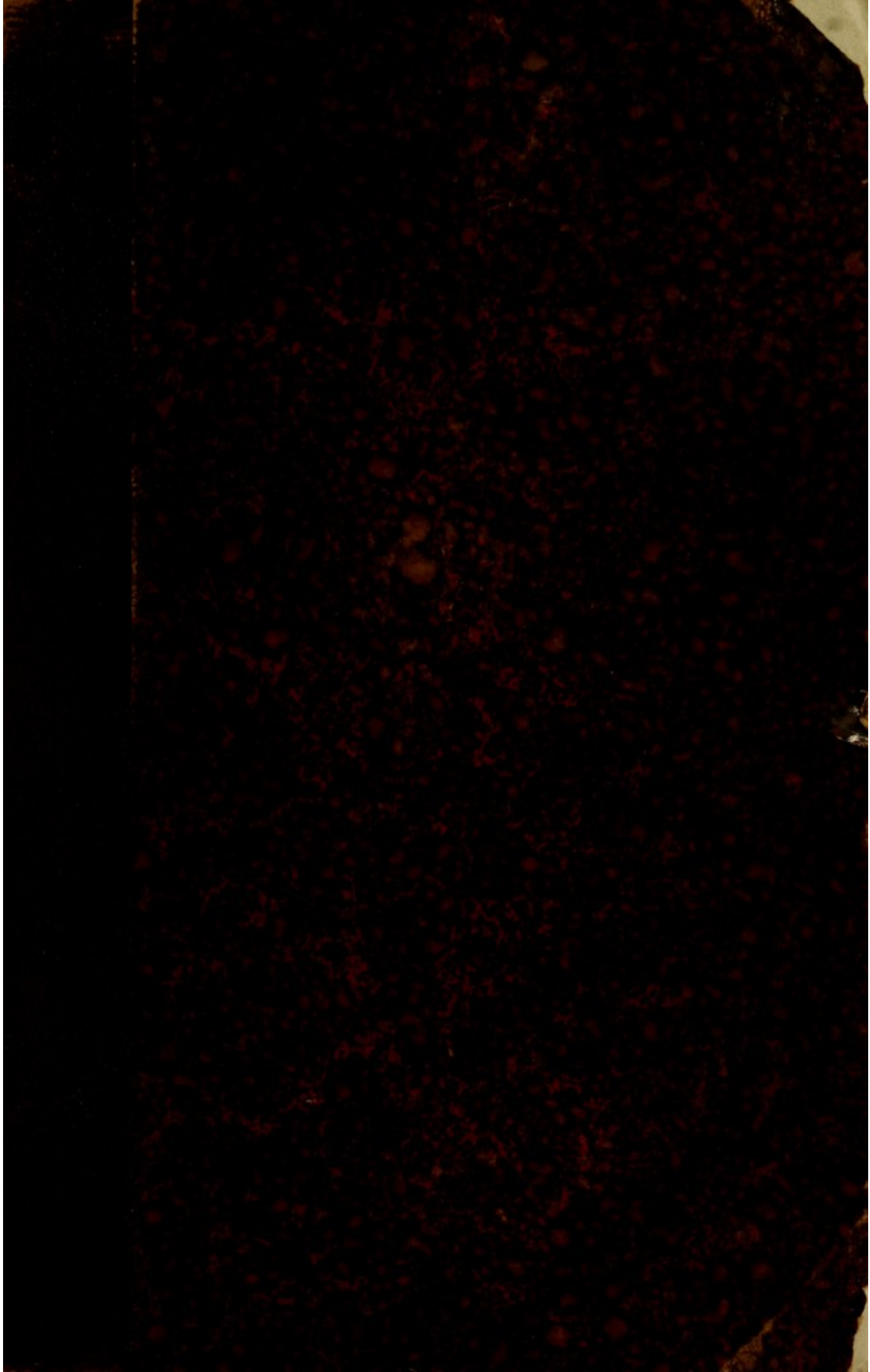
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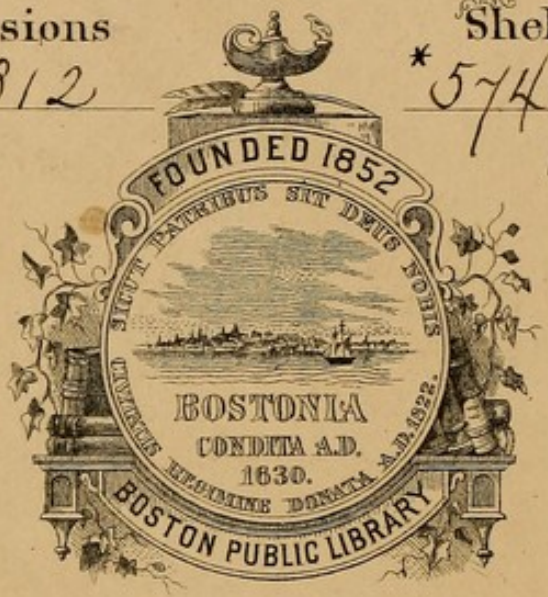


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THE DISEASES

OF THE

BLADDER AND PROSTATE GLAND.

ON

THE DISEASES

OF THE

BLADDER AND PROSTATE GLAND.

BY WILLIAM COULSON,

SURGEON TO, AND LECTURER ON SURGERY AT, ST. MARY'S HOSPITAL, ETC.

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TO THE

FIFTH EDITION.

In the present edition I have adhered to the original plan of the work, and given such additional matter as increased experience has placed within my reach. Since the appearance of the last edition, considerable improvement has been effected in the operation for vesico-vaginal fistula, and the investigation of malignant tumours of the bladder has been successfully prosecuted. I have re-written the chapters on these subjects, together with that on lithotrity, and illustrated them by original woodcuts. I trust that the additions and alterations which I have made will be found to enhance the value of the work, as a practical guide to the surgeon.

London, February, 1857.

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DISEASES

OF THE

BLADDER AND PROSTATE GLAND.

CHAPTER I.

THE URINE.

Of the excretory organs none are more important than the kidneys; none, having their functions diminished, depraved, or suspended, give rise to more alarming symptoms; none, having their structure disorganized, are attended by greater pain, or have that change followed by greater danger. So important and essential are the kidneys to the functions of life, that we find organs either similar or analogous to them in all animals, down to the lowest grade of animated beings. Birds, amphibia, and fishes, have kidneys which are formed of one substance only, resembling the cortical structure in the mammiferæ, without either nipples or calices; and Brugnatelli,

Meckel, and Blainville, have discovered an excretion analogous to urine in insects and mollusca.

Even in vegetables there is an analogous function; for Schuebler and Zeller have ascertained that plants which absorb different organic and inorganic noxious matters by their roots, get rid of them by their leaves.

Physiologists long since observed that of the organic elements of the body the kidney throws off nitrogen, the liver hydrogen, and the lung carbon; and even the more exact views of recent times have hardly overthrown this observation. It clearly appears that the use of the kidneys and of the lungs is to get rid of the chemical products continually produced within the living body by the death and decomposition of the organic parts of which it is composed. It is not necessary that we should strictly bind ourselves to any one of the special theories put forth to explain the successive steps of the transformation of tissue. It is enough if we are satisfied that the textures of the living body do, without ceasing, undergo chemical decomposition, the place of the decayed particles being constantly supplied by the assimilation of new alimentary matters received into the stomach, and that the decomposed parts are removed from the body by the kidneys, by the lungs, and, in some part at least, by the liver. It is quite certain that the food and the oxygen which the living system is constantly receiving from without are not mere stimulants to action, but actually enter into the chemical composition of the substance of which the body consists, and thus while the body remains unchanged, the constituents of the egesta must correspond to those of the ingesta. This is suffi-

ciently proved when the constituents of the excretions now enumerated and those of the skin are compared, qualitatively and quantitatively, with an average amount of food, drink, and oxygen, consumed in a given time by a living body.

Such, then, is the general description of what takes place during the continuance of health. But under the multitude of noxious influences to which the living body is continually exposed, derangements must necessarily occur in the processes just noticed; and the effects of these derangements become apparent in the character of the egesta, more particularly in the secretion of the kidney, by which, in the healthy state, the greatest number of the elements of the body are eliminated. Hence arises the importance of becoming acquainted with the constituents of the urine in health as well as with the changes to which, under a variety of morbid actions, it often becomes subject. In diseases of the bladder and prostate the secretion of urine is frequently so much deranged, as to render a knowledge of the changes which it undergoes indispensable to the successful management of these affections; and the physician might as well attempt to treat disorders of the organs of circulation and respiration without the stethoscope, as the surgeon those now under consideration without such knowledge as that to which I have alluded.

I have, therefore, deemed it necessary to give an account of the changes in this fluid which modern science enables us to detect, and of the practical indications afforded by its various appearances.

Healthy urine contains four classes of constituent elements, viz., water, nitrogenized organic matters,

non-nitrogenized organic matters, and salts. It is thus composed of the same elementary principles as the food and blood. To the second class belong urea and uric acid; to the third, fatty and colouring matters; and to the fourth, the salts, such as the phosphates of the alkalies and of the earths.

Healthy urine varies in quantity, in colour, and in density. The quantity secreted is about forty ounces in twenty-four hours, being smaller in summer than in winter. The specific gravity is from 1·012 to 1·030, the mean density being 1·022. On standing, a slight cloud appears in the urine; after filtration there is little tendency to decomposition; and until this occurs, it is acid to test-paper. The urine is of a more or less deep citrine colour, and, with the exception of the slight cloud just alluded to, it is transparent; but when decomposition commences it becomes turbid. Slight differences in the urine occur in the two sexes, and at different ages. Several chemical re-agents afford copious precipitates from the urine. Lime-water gives a moderate precipitate even after considerable dilution; solution of acetate of lead or of nitrate of barytes causes a copious precipitate, part of which is re-dissolved by nitric acid; sulphuric or nitric acid heightens the colour and smell of urine. The specific gravity of urine varies with the quantity of solid matter it contains. Thus at the specific gravity of 1·014, 1000 grains of urine contain about 32 grains of solid matter; at 1·020 the same quantity is said to contain about 46 grains, at 1·025 58 grains, at 1·030 about 69 grains, and at 1·040 93 grains. But these numbers are not uniformly correct. Indeed other formulæ have been given, all

different and all inapplicable. The solid contents of the urine cannot be inferred from the specific gravity; and the only correct method of estimating them is by actual evaporation and weighing.

Quantity of Urine secreted.—According to Dr. Prout,* the average quantity of urine secreted, within twenty-four hours, in this country, varies from 30 to 40 ounces. Dr. Routh says the average quantity does not exceed 35 ounces. In France, according to Becquerel, the average quantity is 43 ounces in men and 47 ounces in women. Diuresis is the term employed to signify a simple increase in the secretion of the urine; for diabetes implies not only an increase in quantity but also that the urine is saccharine in quality. Diuresis sometimes attends the cold stage of intermittent fevers; in continued fevers of an inflammatory type it forms a favorable crisis, and it sometimes predominates throughout the whole disease in those fevers in which disturbance of the nervous prevails over that of the vascular system. The like observation may be made of eruptive fevers, such as measles and smallpox; nevertheless, a free discharge of urine not unfrequently ushers in malignant forms of eruptive fevers. In inflammations, the urine seldom increases until the crisis occurs, and then diuresis is not unfrequent, for example, in pleuritis, peripneumonia, hepatitis, and cynanche parotidea. Amongst chronic diseases, hysteria, asthma, rheumatism, gout, and spasmodic colic are most frequently accompanied by diuresis.

A scanty secretion of urine attends active inflammation and phlogistic states of the system, as when the in-

* Nature and Treatment of Stomach and Renal Diseases, 5th edit.

flammatory type marks continued and eruptive fevers. In these diseases scanty urine, after a favorable crisis, threatens a relapse. With reference to chronic diseases, we find the urine scanty in congestions of the abdominal organs, in colica pictonum, and some other forms of colic, in diseases of the liver, of the heart, &c.

As a general rule, in disease, as well as in health, when the quantity of urine is increased its density diminishes, and *vice versâ*. There are, however, exceptions to this rule; for example, diuresis with increased discharge of urea, which corresponds to the old diabetes insipidus; and diuresis with saccharine urine, or the true diabetes.

Colour of Urine.—In health the colour of the urine varies in different individuals, from pale straw or citrine to orange, approaching red. As a general fact, it is to be remarked that the colour is deeper in proportion as the constitution of the individual is robust, the circulation active, and the quantity of animal food taken, great.

The urine of persons in health is usually of a pale amber colour; it becomes slightly turbid towards the centre, seven or eight hours after having been passed, and shortly deposits a sediment that rises up in the form of a cone from the centre of the fluid. This sediment which, at first, is in small quantity, increases until decomposition renders the whole of the urine turbid.

It is essential to distinguish whether the colour be owing to the food that may have been taken, or to any medicine that has been administered, for no secretion is more variable in its physical attributes than urine.

The state of the body greatly modifies the quality of the urine. We know, for instance, how limpid, colour-

less, and watery it becomes after any spasmodic paroxysm, and in the cold stage of agues; turbid, yellowish, and mucous at the termination of pituitous or catarrhal affections; golden yellow and turbid in jaundice; turbid, accompanied with deposition of mucus, in catarrhal affections of the bladder.

Paleness and limpidity of urine during a state of health are regarded as the consequence of indigestion; and hence, we find these conditions frequently attending dyspeptic headache; they may also proceed from constipation* or suppressed perspiration. This limpidness of the urine is a dangerous sign in continued and intermittent fevers, and especially in affections of the brain.† In old people the urine is usually pale, dull, and cloudy. Colourless limpid urine, like spring-water, inodorous and insipid, is called nervous urine.

The urine is clear, transparent, and insipid in spasmodic affections, in hysteria, hypochondriasis, and epilepsy. It is equally transparent and clear, but abundant, in diabetes.

Smell of Urine.—The odour of healthy urine is somewhat aromatic without ammoniacal or fetid taint; and resembles, in a great degree, the odour of the perspiration of a healthy man.

The urine of persons affected with stone in the bladder often acquires a highly offensive odour; while that of

* Hippocrates notices this fact. In the Eighty-third Aphorism, Section IV, he says, "Abundant urine during the night denotes that the bowels are not sufficiently open."

† This is another remark to be found in Hippocrates (V, Aph. Seventy-two, Sect. IV), which Celsus (lib. ii. cap. 4) repeats.

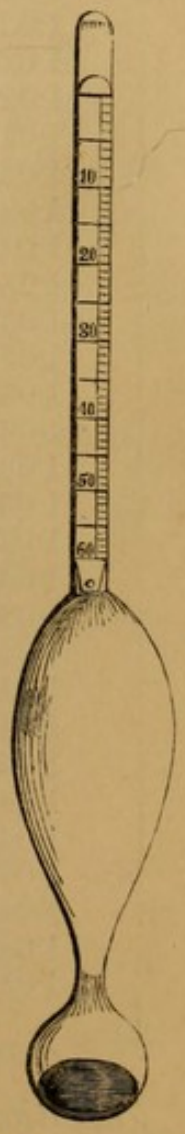
diabetic persons has usually a sweet wheyey smell. Indeed, their whole persons exhale a similar odour.

It has been long noticed, that certain substances when eaten or even when respired, impart a peculiar odour to the urine. Oil of turpentine enters the circulation by respiration, and is conveyed to the kidneys; in the same way the odorous principles of asparagus, valerian, copaiba, cubebs, and many other vegetable substances likewise pass through the blood into the urine. In persons of delicate constitution, and those of a weak digestion, we can often recognise by the odour of the urine the nature and character of the food they have eaten.

Modes of estimating the density of Urine.—To estimate exactly the density of the urine is a point of much moment. The most accurate method of determining its density is by what is termed the 1000-grain bottle. This bottle contains 1000 grains of distilled water. It is sold by the instrument-makers along with a piece of brass which counterpoises it. When it is filled with urine and weighed, the counterpoise being put into the opposite scale, we obtain at once, by its weight in grains, the density of the urine as compared to 1000, the density of water.

The same accuracy may be obtained with any thin phial, though with considerably more trouble. The weight of the phial when empty is first to be determined. It is then to be filled with distilled water and weighed in grains. It is next filled with urine and again weighed in grains, the counterpoise weight being put into the opposite scale. The weight of the water is to the weight

of the urine in the ratio of the density of the water to the density of the urine. Then by the rule of three the density of the urine, as compared with 1000, the standard of water, can easily be brought out. As the weight of the water is to that of the urine, so is one or one thousand to the density of the urine. But since the third term is one, the practical rule is merely to divide the weight of the urine contained in the phial by the weight of the water contained in the same, and the product is the density of the urine as compared with that of water when the standard is made 1 or 1000.



An easier mode, however, of estimating the density of urine, though with less accuracy, is by a small hydrometer, termed urinometer. The urinometer consists of a small globe of glass containing air, beneath which is a much smaller globe filled with a portion of mercury; from the upper part of the larger globe a slender stem arises, to which the scale of degrees is attached. When this instrument is placed in distilled water, it sinks almost to the top of the stem at which the scale commences, being there marked 1. The scale is divided into 60 degrees, and when the instrument is placed in a fluid of greater density than water, the number of the scale at the surface of the water shows how much the fluid exceeds the density of water beyond 1000 up to 1060.

In order to ascertain the quantity of solid matter in 16 fluid ounces of urine, it is only necessary

to refer to the following table constructed by Dr. Henry, which enables us to determine, without the trouble of evaporation, the quantity of extract contained in the pint (16 oz.) of different specific gravities, from 1·020 to 1·050:

Specific gravity at 60° F.	Solid extract in a wine pint in grains.	Solid extract in a wine pint in oz. dr. sc. gr.			
		oz.	dr.	sc.	gr.
1·020	382·4	0	6	1	2
1·021	401·6	0	6	2	1
1·022	420·8	0	7	0	0
1·023	440·0	0	7	1	0
1·024	459·2	0	7	1	19
1·025	478·4	0	7	2	18
1·026	497·6	1	0	0	17
1·027	516·8	1	0	1	16
1·028	536·0	1	0	2	16
1·029	555·2	1	1	0	15
1·030	574·4	1	1	1	14
1·031	593·6	1	1	2	13
1·032	612·2	1	2	0	12
1·033	632·0	1	2	1	12
1·034	651·2	1	2	2	11
1·035	670·4	1	3	0	10
1·036	689·6	1	3	1	9
1·037	708·8	1	3	2	8
1·038	728·0	1	4	0	8
1·039	747·2	1	4	1	7
1·040	766·4	1	4	2	6
1·041	785·6	1	5	0	5
1·042	804·8	1	5	1	4
1·043	824·6	1	5	2	3
1·044	843·2	1	6	0	3
1·045	862·4	1	6	1	2
1·046	881·6	1	6	2	1
1·047	900·8	1	7	0	0
1·048	920·0	1	7	1	0
1·049	939·2	1	7	1	19
1·050	958·4	1	7	2	18

Variations of density.—The density of the urine varies in the same person at different times of the day. When,

therefore, great accuracy is required, the whole of the urine passed in the twenty-four hours should be collected, and a portion tried by some one of the above methods. If the whole of the urine for one day cannot be obtained, the medium should be taken between that of the morning and the evening. It is common to take the morning urine alone; but it appears that, in disease at least, the morning urine is usually less dense than that of the evening. To estimate with accuracy the density of the urine, the quantity passed in a day is to be taken into account along with the density of the whole.

The chemical constituents of healthy urine.—It appears that the urine contains from three and a half to seven per cent. of solid matter, the rest being water. The original analysis by Berzelius, was published in 1809; I shall cite it in the first place, and give in contrast some more recent analyses.

Water	933·00	
Solid residue	67·00	
Urea	30·10	
Uric acid	1·00	
Free lactic acid, lactate of ammonia, alcohol, and water-extract	17·14	
Mucus	0·32	
Sulphate of potash	3·71	Fixed salts 15·29
Sulphate of soda	3·16	
Phosphate of soda	2·94	
Biphosphate of ammonia	1·65	
Chloride of sodium	4·45	
Chloride of ammonium	1·50	
Phosphate of lime and magnesia	1·00	
Silicic acid	0·03	

Simon made two analyses of the urine of a healthy man, aged 33 years, of a decidedly sanguineous temperament, whose digestion and nutrition were not very good. One hundred parts contained—

Specific gravity .	1011		1012	
Water . . .	963·20		956·00	
Solid residue . .	36·90		44·00	
Urea . .	12·46		14·578	
Uric acid .	0·52		0·710	
Alcohol-extract, with free lactic acid	5·10	Extractive matter and ammonia salts. = 10·14	4·800	=12·94 and amm. salts.
Spirit extract	2·60		5·590	
Water-extract and vesical mucus	1·00		2·550	
Lactate of ammonia	1·03			
Chloride of ammonium .	0·41			
Chloride of sodium	5·20	11·19	7·280	13·77
Sulphate of potash	3·00		3·508	
Phosphate of soda	2·41		2·330	
Phosphate of lime and magnesia .	0·58		0·654	
Silicic acid .	a trace.		a trace	

C. G. Lehmann has likewise made some very minute analyses of the healthy urine of a young well-fed man. These analyses approximate closely in their results to those of Berzelius. They were made with the urine which had been passed during the twenty-four hours immediately preceding the experiment. The concentration of the fluid may be explained by the circumstance of the young man by whom the urine was passed having taken only a very little drink, as is the usual habit with persons of a sanguineo-bilious temperament.

	1.		2.		3.	
Water . . .	937·682		934·002		932·019	
Solid residue . .	62·318		65·998		67·981	
Urea . . .	31·450		32·914		32·909	
Uric acid . .	1·021		1·073		1·098	
Lactic acid . .	1·496		1·551		1·513	
Water-extract .	0·621		1·591		0·632	
Spirit and alcohol extract	10·059		9·871		10·872	
Lactates . .	1·897		1·066		1·732	
Chloride of sodium and ammonium .	3·646	15·857	3·602	15·744	3·712	16·130
Alkaline sulphates	7·314		7·289		7·321	
Phosphate of soda	3·765		3·666		3·989	
Phosphates of lime and magnesia . . .	1·132		1·187		1·108	
Mucus	0·112		0·101		0·110	*

The following table gives the mean result of six analyses of the morning urine of a healthy man, instituted by Simon:

Specific gravity . . .	1022·5
Water	961·00
Solid constituents . . .	39·00
Urea	16·60
Uric acid . . .	0·61
Fixed salts . . .	9·27
Organic matter and loss . .	12·07

The apparent discrepancies in the composition of healthy urine, as shown in the analyses that have been quoted, depend for the most part on the fluctuating amount of water. If we calculate the proximate constituents of the urine in relation to an equal amount of solid residue, we shall find these differences exhibited in a much less striking manner, although to a certain degree they still exist.†

* Simon's Animal Chemistry, by Dr. Day, vol. ii, pp. 143, 144.

† Ibid., p. 146.

One hundred parts of the solid residue of the urine contain—

Urea . . .	33·80	33·10
Uric acid . . .	1·40	1·60
Extractive matter, ammonia, salts, and chloride of sodium .	42·60	46·00
Alkaline sulphates . .	8·14	8·80
Alkaline phosphates .	6·50	5·70
Phosphates of lime and magnesia	1·59	1·50*

Water forms the basis of blood and urine, as well as of all animal fluids; nevertheless, in the blood, it appears probable that water exists in two distinct conditions: first, as an integrant constituent of the corpuscular portion; and, secondly, as diffused generally throughout the mass. It is from the latter source that the urine is taken. There is sometimes an increase of the watery portion, whilst the other principles remain the same, or become diminished. In this state of the urine, the urea and the salts bear to each other nearly their ordinary proportion, but are considerably deficient in their absolute quantity. This condition of the urine may be observed in most persons under particular circumstances, especially in the aged: when it is only occasional, much importance is not to be attached to it. But where this state is constant it becomes an important indication, showing great weakness and debility of constitution, and is not unfrequently the precursor of serious local and constitutional mischief. Sometimes the increased flow of urine, as Dr. Prout observes, involves an increased proportion of the natural ingredients, as of urea; or of unnatural ingredients, as of albumen or sugar. On the

* Simon, p. 147.

other hand, the proportion of water is not unfrequently diminished below the natural standard, as in various forms of urinary suppression; and sometimes when the cause of this suppression is mechanical, the urine is simply diminished in quantity, while its composition remains the same: at other times, the suppression is connected with deranged action of the kidneys, and while the proportion of water is diminished, the other ingredients are relatively much increased, as in various forms of gravel and calculus.

Urea.—The chief constituent of the urine is urea. It is an organic constituent, though it differs from other organic constituents in general by being crystallizable. In the last century, Rouelle described a substance in the urine having nearly the characters of urea. His observations were for a long time neglected; at last Cruikshank, when he assisted Rollo in his examination of diabetic urine, made a new step in the discovery of this substance. He showed, in 1797, that a particular crystallizable substance exists in the urine from which it is precipitated by nitric acid. Three years afterwards, Fourcroy and Vauquelin published an elaborate memoir on the urine, in which urea is particularly described. In this paper Fourcroy says, that he and Vauquelin had discovered all that Cruikshank had made known, previously to his publication.

But Berzelius remarks that Fourcroy was hardly the person to suppress, for so long a period, a discovery of this importance. Fourcroy and Vauquelin named the new substance *uree* or urea: they obtained it by evaporating the urine to the consistence of a thick syrup

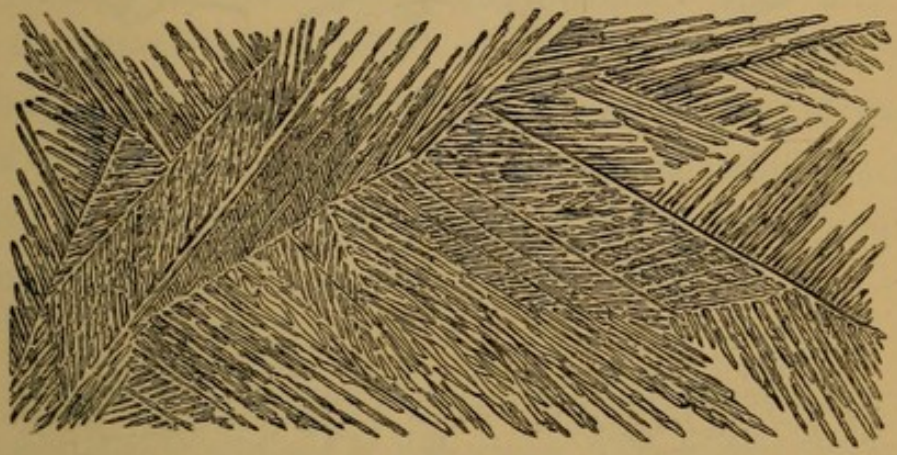
and extracting the urea from this mass by means of alcohol. It is to be remarked, that before Cruikshank or the French chemists had published this discovery, Scheele had discovered the existence of uric acid in healthy urine.

For a number of years no purer form of urea was known to chemists than that which can be obtained by the process of Vauquelin and Fourcroy. At last Berzelius devised a new process, and about the same time Prout also published another. The process of Berzelius essentially consists in extracting first an impure urea from urine evaporated as far as possible to dryness by means of anhydrous alcohol. The impure urea so obtained is freed from colour by charcoal, and being then dissolved in a small quantity of distilled water, oxalic acid is added to it. An oxalate of urea is formed, which is finally decomposed by carbonate of lime, and the oxalate of lime then formed is separated by filtration.

One of the best methods for procuring urea consists in evaporating fresh urine to the consistence of syrup with a gentle heat and mixing it, while still warm, with about half its volume of colourless nitric acid of specific gravity 1·420. The whole now forms a thick crystalline mass. By the action of the nitric acid on the warm solution, heat is developed and effervescence ensues. This is chiefly owing to the destruction of the colouring matter, and if any considerable heat be applied, the urea is not only decomposed, but forms, from the first, nearly white crystals of nitrate of urea. When cold is employed, according to the method formerly recommended, the crystals are very brown, and are purified with difficulty. It is advisable to separate from

the inspissated urine, by crystallization, as much as possible of the chlorides which it contains, before adding the nitric acid.*

The chemical constitution of urea is represented by $C_2N_2H_4O_2 = 60$. Urea is a cyanate of ammonia, and it may be prepared artificially—for example, by Liebig's process. It crystallizes in colourless, transparent, four-sided, somewhat flattened prisms of the specific gravity 1·350.

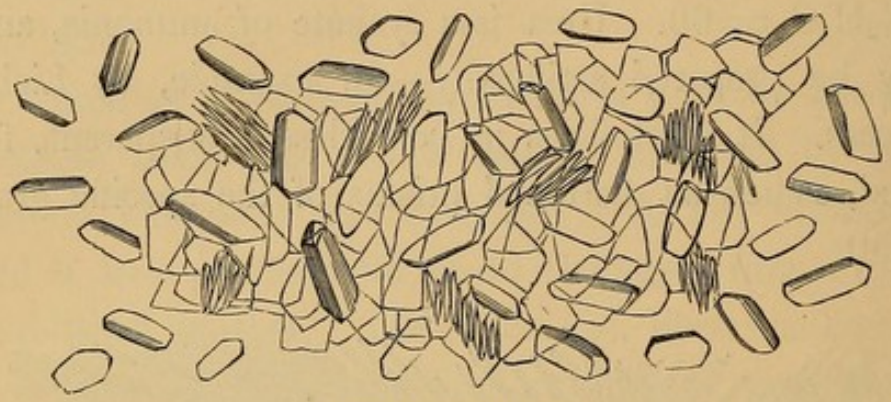


CRYSTALS OF UREA.

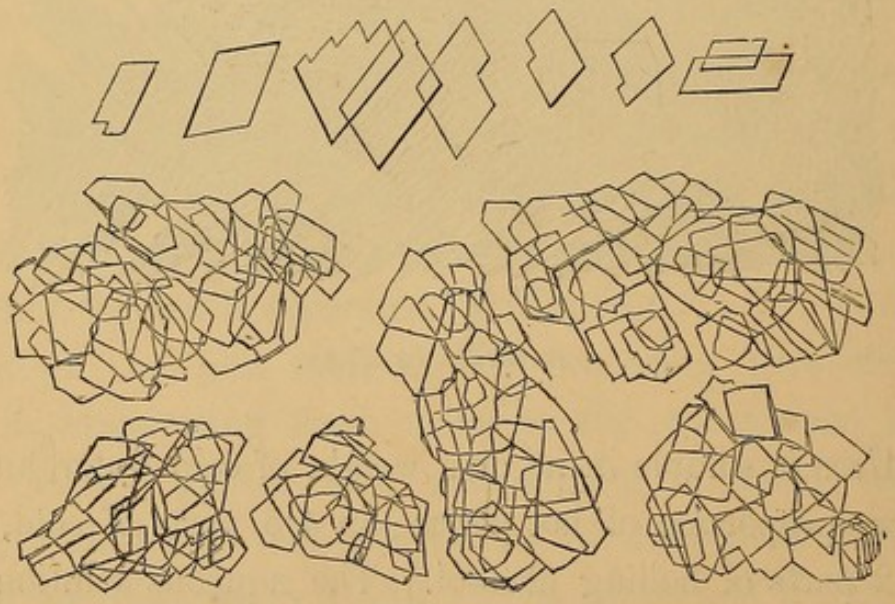
Urea is soluble in its own weight of cold water, and in every proportion of hot water; in 4·5 parts of cold, and in 2 parts of boiling alcohol. The aqueous solution has a cooling bitter taste like nitre. When pure it is perfectly permanent in the air, is not deliquescent, fuses at 250° into a colourless liquid, is decomposed by a higher temperature into ammonia, cyanate of ammonia, and dry solid cyanuric acid. Alkalies do not cause the separation of ammonia in the cold. Urea is an organic base, and

* Cap and Henry; also 'Turner's Chemistry,' by Liebig and Gregory, p. 726.

unites with several acids without decomposition to form crystallizable saline compounds. The chief of its known salts are the nitrate and the oxalate.



NITRATE OF UREA.



OXALATE OF UREA.

About 240 grains, or half an ounce of urea, are daily separated by the kidneys from the blood. This quantity represents five sixths of the nitrogen taken in with the food. Urea cannot be detected in healthy blood, but after the extirpation of the kidneys in animals, in Bright's disease, and also in cholera, it has been distinctly shown to be present in this fluid. It appears also to have been

discovered in the secretion of the skin, in evacuations of the bowels produced by powerful medicines, and it is even said to have been detected in the humours of the eye. In animals, however, after extirpation of the kidneys, it appears that the elements of urea pass from the bowels in the form of carbonate of ammonia.

According to Prout, urea is derived in the living system from the metamorphosis of the gelatinous tissues, while uric acid is derived from that of the albuminous.

Liebig, on the other hand, maintains that uric acid is the immediate product of the decomposition of all nitrogenized tissues, and that, by the action of oxygen and water, it is converted into urea, which is thus, according to him, a secondary product of animal decomposition.

Abnormal states of Urea.—Several names have been applied to denote abnormal states of urea in the urine, such as anazoturia, azoturia, and anuria. The first, viz., anazoturia, includes many cases of diabetes insipidus. *Anazoturia* signifies a discharge of urine which is characterised by a deficiency of urea. Many cases of diabetes reported as cured plainly belong to this condition. It is marked by a great abundance of urine which is limpid and straw-coloured, or wholly free from colour, has a slight faint odour, and affords either a weak reaction with litmus paper or is altogether neutral. Such urine rarely throws down a precipitate within twenty-four hours; but it cannot be kept without undergoing change, and usually becomes faintly ammoniacal. It forms a fine creamy pellicle containing minute pearly white crystals of ammoniaco-magnesian

phosphate, and when submitted to analysis only a small quantity of urea can be detected in it. The specific gravity of the urine but little exceeds that of distilled water. Caustic potash precipitates from it a few flocculi of urate of ammonia. This condition of the urine is most commonly observed in ill-fed children, whose bodies are emaciated although the abdomen is protuberant; there usually exist at the same time a voracious appetite and great thirst.

Azoturia signifies a discharge of urine characterised by a superabundance of urea. This affection is another of the morbid states which have been described under the name of diabetes insipidus. The quantity of urine secreted is often unusually large; this fluid is transparent, and most commonly light-coloured, though in some instances it is so dark as to have been likened in colour to porter; it exhales a faint urinous odour, and has an acid reaction with litmus paper; the specific gravity is commonly high, varying at different times of the day between 1·018 and 1·035.

When the density of this urine is at the highest, it affords crystals of nitrate of urea on the addition of nitric acid after a few hours' rest, and without being previously concentrated,—and even when the specific gravity is somewhat less, crystals of nitrate of urea are obtained on the addition of nitric acid with a less previous concentration than is usually required.

The symptoms attendant on this kind of constitutional disturbance are commonly loss of strength, feelings of languor, a greater or less degree of emaciation, some thirst, frequently a sense of sinking, and an uneasy gnawing pain at the pit of the stomach. The patients

affected with this malady often show a peculiar anxiety of expression and cast of countenance, which, according to Dr. Willis,* is common to most of the diseases characterised by a too copious secretion of urine variously altered in its qualities.

It was once supposed that urea is altogether absent in the urine of the true diabetes. This has been found to be an error. It is now many years since this mistake was suspected; Dr. Henry was among the first to discover that urea uniformly existed in a certain proportion in diabetic urine; then Mr. Kane held that it is present in as large a proportion as in health; and finally Mr. Macgregor showed that, under certain circumstances, diabetic urine contains a larger proportion of urea than healthy urine. According to the last-named author, a patient labouring under diabetes mellitus, who had undergone no treatment, passed 1013 grains of urea daily, while the estimated quantity of that passed by a person in health was no more than 428 grains; again, a second patient was found to be passing 945 grains, and a third 810 grains of urea every day. He adds that a patient fed on beef and water exclusively for three successive days passed by the urine 43 grains of urea for every 1000 grains of urine; while the same quantity of healthy urine rarely contains so much as 30 grains. The increased specific gravity of diabetic urine is not, however, in general, due either to an excess of urea, of uric acid, of the urates, or even of the saline ingredients, but almost exclusively to the large proportion of sugar which is present.

* 'Urinary Diseases and their Treatment,' p. 20.

There is one morbid state of the urine, however, in which the increase of specific gravity is plainly dependent on an excess of urea, viz., that which is termed the oxalic acid diathesis. When oxalate of lime is present in the urine, the density is generally above the healthy standard, and this increase of density appears to be owing to an excess of urea. Thus in the morbid condition of the system depending on the presence of oxalate of lime, the urine, though it agrees with that of diabetes in showing a higher density, has no other analogy with it; deposits of uric acid and urate of ammonia being also frequent in this state.

The form of disease, termed azoturia by Dr. Willis, is common in children, and not unfrequent in persons who live freely. It especially attacks persons of spare habit and nervous temperament. There are the same hollow-eyed anxiety of expression mentioned, thirst, and emaciation; but the debility is not so marked as in the former affection. There is, however, the same sense of sinking and uneasy gnawing pain at the pit of the stomach. It has been observed to attend on peritonitis and certain continued fevers of bad type. The prognosis is not, however, so unfavorable as in the former affection.

While treating of urea it is proper to mention its absence in the secretion of urine. This is the disease which Dr. Willis terms *anuria*, and it corresponds to what has been so long known as the ischuria renalis. It is well known that when this morbid condition continues for a few days, death occurs by what has been termed apoplexia venenata. Professor Christison first pointed out the suppression of the excretion of urea as a

probable cause of unlooked-for fatal results in acute diseases generally. Professor Henderson of Edinburgh, afterwards drew attention to cases of epidemic continued fever in which the defective excretion of urea appeared to give rise to fatal affections of the brain, affirming that in such cases urea might be detected in the blood, and even in the serum collected from the ventricles of the brain. The same morbid state of the urine is often observed in inflammations, in the anasarca which follows scarlatina, and after severe surgical operations. Sometimes this affection seems to be idiopathic, and has been described in children under the title of urodialysis neonatorum. Infants so affected void the urine in small quantities, which is of high colour, and gives a deep reddish yellow stain to the linen; it causes great pain in its passage, scalding the surface over which it runs, and excites inflammation in the mucous lining of the bladder and urethra, as is indicated by the quantity of mucus which the urine contains. There is much febrile excitement, the skin is hot and dry, the bowels obstinately constipated, the fæces appear as rounded masses like marbles; the digestion is plainly impaired, the breath has a strong vinegar smell, and, as is often the case in urinary affections, the skin is generally irritable and the seat of various kinds of eruptions.

There is also an analogous disease in the decline of life termed the urodialysis senum, and described by Schönlein. This disease usually sets in with constipation of the bowels; the skin is rough and dry; the tongue is covered with a white fur, and is red at the margins; the digestive powers are weakened; the appetite fails or is irregular: there are acid eructations

and much thirst. The skin, as in the infantile disease, is apt to be covered with eruptions.

Before leaving the subject of urea I must not omit to mention the experiments performed by Dr. Lehmann of Leipzig. This eminent physician compared the proportion of urea excreted while he lived on a strictly animal diet with that given forth when his food was wholly vegetable, also when it was a mixed diet, and when the diet was quite free from nitrogen, as consisting of starch, gum, oil, sugar, &c. When his diet was wholly animal, the amount of urea obtained in twenty-four hours was 819·2 grains; when his diet was wholly vegetable in the same period there were obtained 346·5 grains; when his diet was mixed the quantity obtained was 500·5 grains, and when his diet was free from non-nitrogenized substances the quantity was no more than 237·1 grains. Lecann has also made some important observations on the variations in the secretion of urea according to the age of the individual. He found the average quantity of urea secreted by adult men in twenty-four hours to be 431·9 grains, while 13·09 grains of uric acid were thrown off in the same time,—the quantity of urea in adult women to be 284·2 grains, the uric acid in the same period being 10·01 grains,—the quantity of urea in very old men (84 to 86 years old) 124·8 grains, while the uric acid in the same period was 6·77; the quantity of urea in children under 8 years 138·2 grains, the uric acid in the same time being 3·98 grains.*

* Lehman's 'Physiological Chemistry,' translated by Dr. Day, vol. i.

Uric Acid.—Uric acid is another most important constituent of the urine. It was discovered in the last century by Scheele, who found this substance to form a principal part of some urinary calculi which he analysed; and hence he was led to search for the same substance in the urine of healthy persons. He called it lithic acid, for which name Fourcroy afterwards substituted that of uric acid. It exists in the urine of men and carnivorous animals, but not in that of the herbivorous mammalia. It is, however, found very commonly in other classes of animals, even in those of the lower tribes. Uric acid is deposited from human urine while it cools, and generally in combination with ammonia or with soda as a yellow or brownish powder. The stone-like concretions in the joints of persons labouring under gout contain uric acid in combination with soda or ammonia. It is the basis of the great majority of calculi found in the bladder. The semi-fluid urine of serpents and birds is principally composed of urate of ammonia. Uric acid crystallizes in flat scales of a brilliant white colour and silky lustre; it is tasteless and inodorous, heavier than water; almost insoluble in cold water, and slightly soluble in boiling water: the solution reddens feebly the vegetable colours. It is dissolved by concentrated sulphuric acid; and from the solution it is precipitated by water; it is somewhat more soluble in strong hydrochloric acid than in pure water. Uric acid, when exposed to destructive distillation, affords the same products as are obtained by the decomposition of urea, viz., urea, cyanuric acid, and cyamelide (the insoluble cyanuric acid), also hydrocyanic acid, a little carbonate of ammonia, and, as a residue, a brown

carbonaceous substance which is rich in nitrogen. It dissolves in dilute nitric acid with the evolution of equal volumes of pure carbonic acid and nitrogen; the solution contains alloxan, ammonia, and some other compounds; and this solution, if evaporated and treated with ammonia in excess, acquires a purple red colour, a test by which uric acid may be recognised. Uric acid is insoluble in ether and alcohol. With sulphuric acid it forms a crystalline compound. Its chemical composition is thus represented, $C_{10}N_4H_4O_6$.

The average amount of uric acid excreted in twenty-four hours in adults is 8·1 grains, combined according to some, with soda, according to others, with ammonia. Since at least 10,000 parts of water at 60° are required to dissolve one part of uric acid, and there must be one part of this substance in 2500 parts of urine, it is plain that it cannot exist free in the urinary secretion. The compound which uric acid forms with ammonia requires 480 parts of water for its solution. Hence, were it combined with ammonia in the urine, it would remain dissolved at ordinary temperatures, but according to Dr. Bence Jones, uric acid, in the state in which it exists in the urine, requires for its solution 2·789 parts of urine, and he has also pointed out that the presence of a moderate quantity of saline matter increases its solubility. According to Dr. Golding Bird,* the 8·1 grains of uric acid uniformly secreted in twenty-four hours require but 0·82 grains of ammonia for saturation, and the 8·92 grains of urate of ammonia thus formed would be held in solution by less than half a pint of water, or

* 'Urinary Deposits,' 4th edit., 1853.

about a fourth of the quantity separated by the blood from the kidneys. When healthy urine is slowly evaporated in an air-pump vacuum, it soon becomes turbid from the formation of clouds of urate of ammonia,* which ultimately subside in very minute spherical masses on the sides of the vessel. The same thing occurs when urine of a rather high specific gravity is exposed to cold. These facts have been regarded as conclusive in favour of Dr. Prout's opinion, that the chief part of the uric acid in the urine exists combined with ammonia.

Acidity of Urine.—Litmus paper is the best immediate test for detecting acidity in urine. When the urine is acid, the blue colour of the paper is changed to a red. Turmeric paper, or reddened litmus paper, are the best tests for ascertaining whether urine be alkaline or not. Alkaline urine turns the yellow colour of the turmeric paper brown, and changes the colour of the red litmus paper to a blue: this latter is a much more delicate test than the former. After the discovery of uric acid, the acid reaction of healthy urine to test-paper was naturally ascribed to the presence of that acid. Berzelius first threw doubts on this opinion, affirming that the acidity of the urine is due to the presence of lactic acid. Prout, on the contrary, ascribed the acidity of the urine to the presence of urate of ammonia, and various other opinions have since been published on

* Lehmann, however, asserts, in his last edition, that the amorphous lithates do not contain ammonia, but that which is termed urate of ammonia is, in fact, urate of soda.

this point, among which the chief is that the acidity of the urine is due to the presence of free phosphoric acid or to uric acid dissolved by the presence of a phosphate.

Dr. Bence Jones* has made some important observations on the variation in the acidity of the urine under different circumstances. From his experiments it appears that immediately before a meal urine exhibits the greatest degree of acidity, and that it is marked by a lower degree of acidity when it is passed two, three, or more hours after food. He found that the decrease of acidity was greatest three hours after breakfast, and that five or six hours after dinner it reached its lowest point. The acidity of the urine then increased until immediately before the time of taking food, when it again reached its highest limits. When food was not taken the urine did not decrease in acidity, but continued nearly in the same state for twelve hours, and if food was then taken the acidity diminished.

When the diet was confined to animal food the decrease of acidity after food was more striking and more durable than when a mixed diet was used. The increase, however, of the acidity before food was hardly so great in this case as when a mixed food was employed; if vegetable food alone was taken the acidity did not sink so much as when animal food was used, that is, though the urine after food became neutral, it failed to become highly alkaline; the increase in the

* 'Animal Chemistry in its Application to Stomach and Renal Diseases,' 1850.

acid quality of the urine was greater before vegetable food than it was when animal food was taken.

According to the experiments of the same author, the use of dilute sulphuric acid at the same time hardly altered these results; but he found that tartaric acid in large doses produced a marked effect on the acid character of the urine. He observed that liquor potassæ in large doses had a great effect in diminishing the acidity of the urine, though it by no means rendered the urine constantly and permanently alkaline, its effect passing away rapidly. He found that tartrate of potash quickly produced a very decided effect on the acidity of the urine; 120 grains of pure dry tartrate of potash dissolved in four ounces of distilled water made the urine alkaline in 35 minutes; in two hours the alkalescence had disappeared, but after the next meal the effect of the tartrate of potash was again apparent. Ten drachms of tartrate of potash in three days produced but little, if any, effect on the acidity of the urine, after it had been omitted for twenty-four hours.

Thus it appears from these experiments that the acidity of the urine is always changing, and that these changes depend on the state of the stomach at the time. If there be much acid in the stomach, the acidity of the urine increases, and it commonly reaches its highest limit before food is again taken. Animal food causes a greater variation than vegetable food, and when no food is taken the variation is very slight.

Dr. Bence Jones does not attempt to solve the question—what is the cause of the acid character of the urine? He thinks it most probable that it is dependent on the presence of acid phosphate of soda.

He thinks it likely that there is generally no free acid in the urine, and that the reaction is due to the presence of an acid salt; though he admits that the quantity of phosphate of soda is sometimes so extremely small as to be incapable of producing the acidity present even under such circumstances.

Dr. Bence Jones infers that the urate of ammonia cannot be the cause of the acid character of the urine, because when the urine is nearly alkaline there is not unfrequently a great abundance of that salt. He states, also that the quantity of urate of ammonia varies remarkably, and is but little affected by different kinds of food; nevertheless a few hours after any kind of food the quantity is increased, and long after all food the acidity of the urine is greatly increased.

Dr. Golding Bird gives the following as a probable explanation of the mode in which uric acid exists in healthy urine. "Uric acid at the moment of separation from the blood comes in contact with the double phosphate of soda and ammonia derived from the food, forms urate of ammonia, evolving phosphoric acid which thus produces the natural acid reaction of the urine. If the whole bulk of the urine be to the urate of ammonia formed, not less than about 2701 to 1, the secretion will, at the ordinary temperature of the air, remain clear, but if the bulk of the fluid be less, an amorphous deposit of the urate will occur; on the other hand, if an excess of uric acid be separated by the kidneys, it will act on the phosphate of soda of the double salt, and hence on cooling the urine will deposit a crystalline sediment of acid sand, very probably mixed with amorphous urate of ammonia, the latter usually

forming a layer above the crystals, which always sink to the bottom of the vessel."*

Before leaving this account of uric acid in the healthy state of the body, it must be mentioned that Dr. Garrod has shown, by an ingenious set of experiments, that traces of uric acid may be detected in the blood. Professor Scherer has further discovered uric acid in considerable proportion in the spleen, and it appears with hypoxanthine to be an important immediate result of the destructive metamorphosis of this singular organ.

The deposits from the urine, termed uric acid deposits, consist either of uric acid, or of uric acid with urates. When uric acid exits in such a deposit uncombined with a base, it is invariably in a crystalline form, that is, it does not occur in the state of an impalpable amorphous powder. These crystals of uncombined uric acid are seldom free from colour, being most commonly of a yellow or amber tint. They present, however, every shade of colour, from the palest fawn to the deepest amber or orange red, and hence the term yellow or red sand commonly applied to them. As a general rule the higher the colour of the urine the darker are the sediments.

Deposits of uncombined uric acid, when heated in the urine, do not dissolve, but the crystals become opaque. Heated with liquor potassæ, the uric acid deposit dissolves, the urate of potass produced being highly soluble. Nitric acid quickly dissolves the deposit, and by careful evaporation, a beautiful pink-

* 'Urinary Deposits,' &c., *fourth edition*, 1853, p. 84.

coloured substance is obtained, which on being held over the vapour of ammonia becomes of a rich purple. This coloured substance is the murexide of Liebig, the purpurate of ammonia of Prout. Subjected to heat in a platinum spoon, the uric acid deposits readily burn, giving off an odour of bitter almonds, the residue being usually a small quantity of white ash, in which there is phosphate of soda or phosphate of lime, or both.

When there is an excess of uric acid in urine, crystals commonly fall when it cools; at other times many hours elapse before a deposit takes place, even when there is comparatively a larger proportion present, and this is frequently observed in gouty persons. At other times the acid is not deposited at all; but forms a crystalline pellicle on the surface, affording prismatic colours when placed in a bright light. The urine which deposits uric acid is usually of a deeper amber tint than natural, and is sometimes of a reddish-brown colour. From very high-coloured urine, however, uric acid is seldom deposited until after the addition of a stronger acid; the whole of the uric acid present in the urine is never spontaneously deposited until after the commencement of decomposition, and therefore urine filtered from a sediment of this kind, on the addition of a drop of nitric acid, usually affords a copious deposition of crystals of uric acid in a few hours.

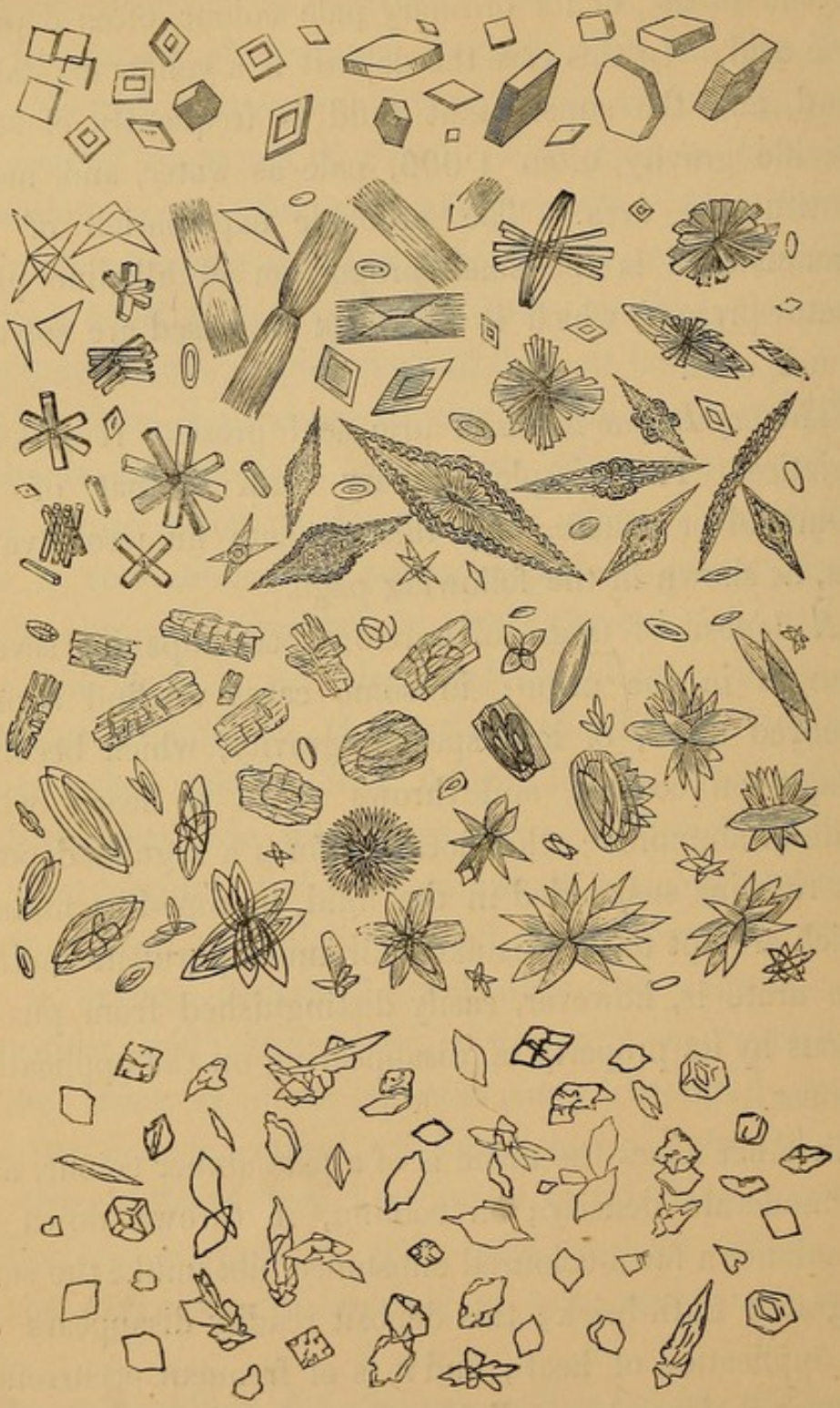
The urine which deposits uric acid invariably reddens litmus paper, and often contains so much urea as to afford crystals slowly without evaporation when mixed with nitric acid. The specific gravity of such urine is commonly above 1·020; the urine, however, of infants

at the breast, of its ordinary pale colour, often deposits uric acid. In this case the deposit is a yellow crystalline sand, and the supernatant fluid is frequently of small specific gravity, often 1·006, pale as water, and nearly destitute of urea. The probable explanation of this circumstance is the small proportion of alkaline phosphates present, which it has been supposed are solvents of uric acid.

The crystalline forms of uric acid present remarkable varieties. The simple primary form is that of the rhomboid or square, and this presents numerous varieties, as shown in the following page.

A deposit of urate of ammonia accompanies several changes in the urine; in some cases we find a pale-coloured urine, of low specific gravity, which becomes opaque on cooling, and throws down a nearly white urate of ammonia; this does not form a regular deposit, but remains suspended in the fluid, in rope-like masses, which are apt to be mistaken for muco-purulent matter. The urate is, however, easily distinguished from pus or mucus by its property of disappearing on the application of heat.

In other cases the urine is of a pale amber colour, and of moderate density; on cooling, it throws down in abundance a fawn-coloured substance, not unlike the sand of grated Bath-brick; this deposit readily disappears on the application of heat; and it is of frequent occurrence, because it depends on slight obstruction of the cutaneous perspiration. Again, under febrile excitement the urine becomes concentrated, increases in density, and deposits on cooling a reddish-brown sediment; this is the well-known lateritious or brick-dust sediment. It is to be

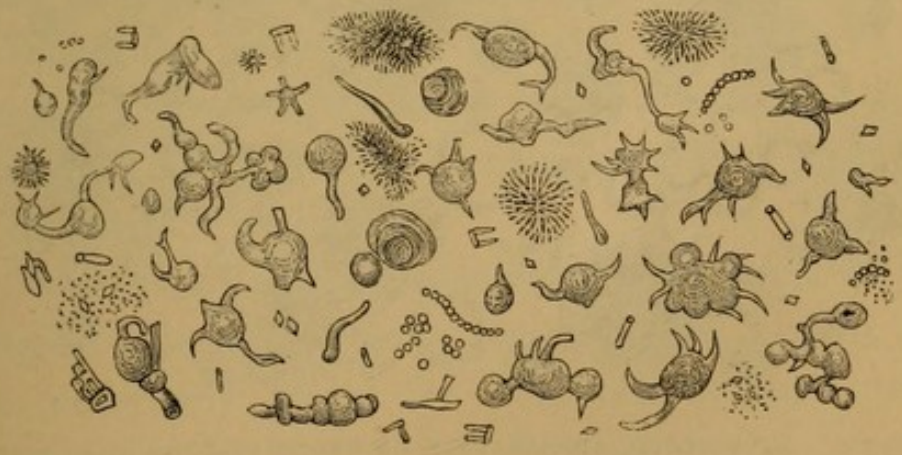


URIC ACID CRYSTALS.

remarked that a drop of nitric acid renders the urine in this case turbid, not, as has been erroneously supposed, from the coagulation of albumen, but from the precipi-

tation of uric acid in minute microscopic crystals. Lastly in certain cases of internal disturbance, as in affections of the portal circulation, connected with diseases of the liver or spleen, and sometimes when suppuration is going on internally, the urine exhibits a deep purple or copper colour, often verging on crimson. These deep tints, according to Dr. Golding Bird, depend on the presence of an excess of purpurine. When in such urine a deposit of urate of ammonia occurs, it combines with the pink pigment so as to form a kind of lake, often so abundant as not to disappear entirely by heat until the urine is diluted with water. From these deposits the colouring matter is easily separated by alcohol.

The common form of urate of ammonia is that of exceedingly minute globules, cohering in irregular masses, but it is occasionally found in the shape of larger globules, with one or more caudate processes as seen in the following drawing.



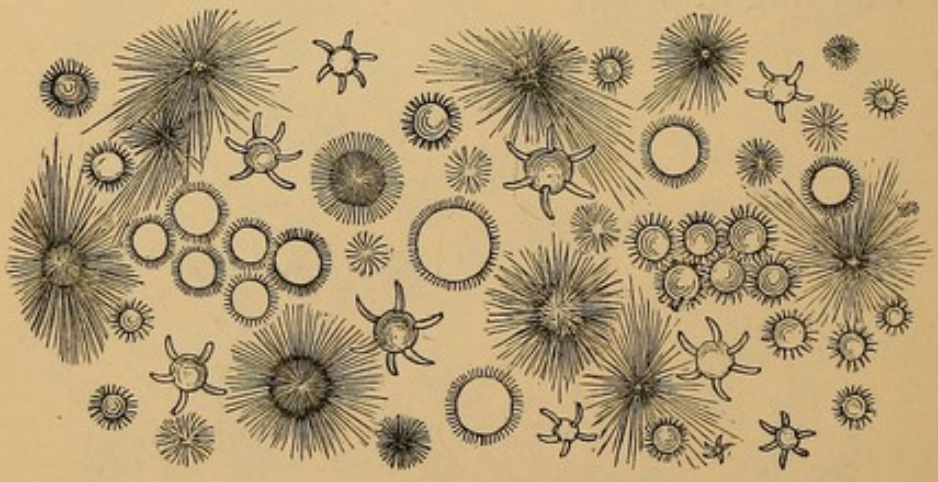
MICROSCOPIC APPEARANCES OF URATE OF AMMONIA.

According to Dr. Bence Jones, the proportion of urate of ammonia present in the urine is not indicated with certainty by the amount of the deposit, for if the

urine is less acid than usual, it will hold dissolved much more of this salt than when of average acidity, and again, very acid urine may afford a deposit of urate of ammonia although a moderate proportion of that salt is present.

Of the other salts which uric acid forms, the urate of soda is the most remarkable; it constitutes the tophi or concretions of the joints in gout; but may be found under other conditions, as in the urine of persons suffering under fever, who have been treated with carbonate of soda.

Under the microscope this salt presents the appearance of crystalline needles, radiating on all sides from a central mass. Sometimes the central mass is very small, or even absent, and the stellate form is produced by the acicular crystals crossing each other.



MICROSCOPIC APPEARANCES OF URATE OF SODA.

The disintegration of tissues and nitrogenized food form the two principal sources of uric acid. In all diseases attended with great emaciation, the urine contains an increased quantity of uric acid, if the kidneys are

able to perform their functions. The same effect is produced during acute inflammatory affections; and deposits of uric acid, either free or combined, are commonly present in the urine during diseases which materially influence the circulation of the blood. In gout and rheumatism there is a striking tendency to the formation of an excess of uric acid both in its pure and combined states. In gouty affections urate of soda appears to be generated in so large a quantity that the fluid part of the blood is no longer sufficient for its solution, and hence a portion of the salt is deposited in the joints and sheaths of the tendons, producing painful swellings.

Dr. Garrod has succeeded in discovering urate of soda in the blood of gouty patients.

In chronic diseases attended by excessive debility, particularly where an anæmic or chlorotic state exists, a deficiency of uric acid occurs, and the salt is never thrown down until the fluid is condensed by evaporation.

When the functions of the skin are impaired, an excess of nitrogen is retained in the blood, and afterwards separated by the kidneys in the form of urate of ammonia.

An excess of uric acid may exist in the urine without forming a deposit, and the presence of a depo-it does not necessarily imply the existence of an unusual proportion; if, however, a deposit of the urate of ammonia occur when the bulk of the urine passed in four-and-twenty hours is not below the average, it is pretty certain that an excess of uric acid exists. On the other hand, if the bulk of the urine be much less than natural, the deposit may occur merely

because there is not enough of water to hold the uric acid in solution.

The most serious effect of the formation of uric acid in excess within the system is the production of urinary calculi; this acid forms a large proportion of the whole number of calculi, and even when these are chiefly composed of other constituents, the nuclei on which they are deposited are for the most part composed of uric acid. Urate of ammonia, owing to its solubility, rarely forms, except in children, entire calculi; but combined with other ingredients it often enters into their composition.

Whenever an excess of uric acid is remarked in the urine, our principal object should be to promote the functions of the skin and improve the powers of digestion. Among special remedies, preparations of iron and colchicum deserve particular attention; to these are to be added various remedies which seem to act as solvents of uric acid, such as the alkalies and their carbonates, biborate and phosphate of soda, benzoic and cinnamic acids.

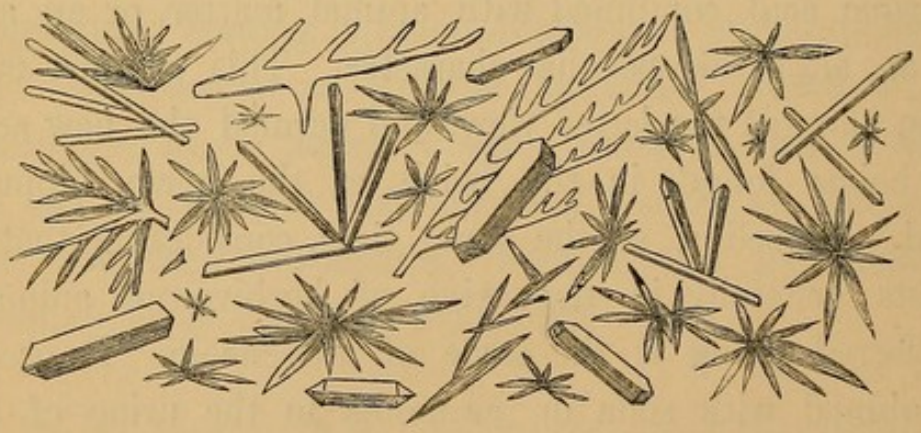
Lactic acid.—I have already remarked that Berzelius ascribed the acidity of the urine to the presence of lactic acid. Much doubt still exists as to whether this acid and its salts be or be not ordinary constituents of the urine. Simon regards lactic acid as uniformly existing in the urine, and like Berzelius enumerates lactate of ammonia as one of its ingredients. Lehmann, Marchand, and Becquerel agree with Berzelius and Simon in retaining this acid and its salts as a part of the chemical constitution of the urine. Heintz

also appears to have shown that though lactic acid is not the cause of the acidity of the urine it is nevertheless present among its constituents.

Hippuric Acid.—At an early period in the chemical history of the urine, several acids were announced as existing in it, besides the uric. Prout and Thenard believed that acetic acid is present in healthy urine; this, however, was disproved. At a still earlier period it was announced that benzoic acid exists in the urine of children, and of herbivorous animals. Rouelle found that hydrochloric acid precipitated from the urine of the cow, after evaporation, a salt which he compared to the flowers of benzoin. It is now more than twenty years since Liebig showed that this precipitate is either benzoic acid combined with animal matter, or an acid of an altogether peculiar character. This chemist even then adopted the latter view, and termed the new acid, as being found in the urine of the horse, hippuric acid. Berzelius, at the same time, considering that it exists generally in the urine of herbivorous animals, preferred giving it the name of urobenzoic. It occurs combined with soda or ammonia in the urine of the horse and cow; from the urine of these animals it is obtained by boiling with an excess of milk of lime, straining, boiling down the clear liquid to one tenth of its original volume, adding so much hydrochloric acid as to produce an acid reaction, and setting the fluid aside to rest, when coloured hippuric acid is deposited in crystals. Though Liebig has carefully proved its existence in human urine, the quantity present appears to be too small to admit of its being easily detected. After

purification, the hippuric acid forms long transparent or milky-white, four-sided prisms acuminated on two faces, having a slightly bitterish taste; it reddens litmus paper, and melts when heated, but concretes into a crystalline mass on cooling.

A high temperature decomposes it; in which case benzoic acid and benzoate of ammonia distil over in red oily drops, which have a strong and agreeable odour of tonka beans, and become solid. Hippuric acid is soluble in 400 parts of cold water, but is easily dissolved at a boiling heat. Nitric acid converts it readily into benzoic acid. The same change is effected by boiling with muriatic acid. If gently heated with



HIPPURIC ACID CRYSTALS.

hyper-oxide of manganese and sulphuric acid, it is redissolved into carbonic acid, ammonia, and benzoic acid.

Urine which contains an excess of hippuric acid is for the most part either slightly acid or neutral, often alkaline. Deposits of the triple phosphate of magnesia

are not unfrequently seen in such urine. When present in unusual quantity it may be detected (in the human urine) by evaporating it in a large watch-glass over a lamp to a few drops; half the bulk of hydrochloric acid is then to be added and the mixture to be set aside. When the acid is added the mixture becomes bright pink, and an odour resembling that of new hay is perceived. In a few hours the characteristic linear crystals of hippuric acid will be discovered. To remove all doubt, a portion of these crystals may be dissolved in water or in alcohol, and on placing a drop of the solution on a plate of glass beautiful crystals, discoverable by the microscope, will be obtained after the evaporation of the fluid.

When an excess of hippuric acid exists in human urine the change commonly depends on peculiarities of food. It was traced in one case to a long confinement to a milk diet; in another to the almost exclusive use of apples. It does not seem to interfere in man with the production of uric acid. But for the most part there appears to be a deficiency of urea when hippuric acid is present. It has been observed to co-exist with albumen in the urine. Dr. Garrod has detected hippuric acid in the blood. Mr. Ure has advised the use of benzoic acid in the belief that by its metamorphosis into hippuric acid it can destroy the alkaline condition of the urine.

Creatine and Creatinine.—Creatine is a crystalline substance first noticed by Chevreul in the juice of the flesh of animals. It is said to be a product of the metamorphosis of muscular tissue under the influence

of destructive assimilation. An ounce of urine is evaporated to the consistence of syrup, and the clear fluid is poured off from the deposited salts; a small piece of fused chloride of zinc is now added to the fluid, which is, at the same time, warmed; it is then set aside for twenty-four hours, when a deposition of minute granular crystals takes place. These crystals consist of a triple compound of zinc and chlorine with creatine and creatinine, and under the microscope have quite a peculiar aspect.* These substances were first discovered in the urine by Dr. Pettenkofer. Creatine occurs in colourless transparent lustrous rhombic crystals, is perfectly neutral, and crystallizes from its solution in tufts like acetate of lead. These crystals contain 12 per cent. of water, are soluble in 74 parts of cold water, and are nearly insoluble in strong alcohol. Creatine contains, when dry, nearly 32 per cent. of nitrogen. Creatinine contains as much as 42 per cent. of nitrogen, and differs from creatine in possessing a highly alkaline reaction. It is soluble in about 11 parts of cold water and about 10 parts of cold alcohol; from its aqueous solution it crystallizes in small prisms. It forms salts with acids. According to the most recent views these substances are excrementitious, and it is probable that a considerable portion of creatine is resolved into uric acid or urea before its final elimination.

Mucus; Epithelial Debris.—A portion of mucus derived from the bladder and urinary passages is in-

* Golding Bird, 'Urinary Deposits,' pp. 4 and 96.

variably present in the urine. The morning urine of health, however, is the best adapted for exhibiting this substance.

When the urine, after being allowed to rest, is held between the light and the eye, a delicate cloud is observed, and if this urine be passed through a paper-filter, the mucus will form upon it a thin layer like varnish. The proportion of mucus in the urine varies considerably under different circumstances. At one time it forms a remarkable flocculent cloud, at another time it renders the urine so viscid that it may be poured from one vessel into another in the form of a tenacious rope. When a portion of this mucus is placed under a microscope it exhibits distinct mucous granules and epithelial cells. It has been observed that urine abounding in mucus is generally alkaline, and soon undergoes putrefaction. This is an important fact, since for the production of alkaline urine, all that seems requisite is that it should be retained in the bladder for a longer time than usual. It has been commonly supposed that alkaline urine is among the symptoms of spinal disease; but we must not forget that owing to the paralytic state attendant on such a disease the bladder is often imperfectly evacuated, and therefore decomposition, with the production of ammonia rendering the urine alkaline, takes place before it is discharged.

The essential cause of an increase in the quantity of mucus in the urine is the presence of irritation of some kind in the urinary passages. The presence of a calculus affords a good example. Sometimes it is dependent on an inflammatory affection of the mucous lining of the bladder, and is often attended with a

great increase in the proportion of phosphates in the urine.

The treatment of affections accompanied by increased secretion of mucus must vary according to the circumstances of its origin; not unfrequently astringents, the uva ursi, the chimaphila, buchu, and pareira brava have proved serviceable.

Non-azotized Substances; Colouring Matters.—When a test-tube is filled to one third with urine, boiled over a lamp, and a fourth part of its bulk of hydrochloric acid added, a fine pink or purple colour is produced depending on the separation of the peculiar colouring matter of the urine. This pink pigment dissolves easily in weak hot alcohol, communicating to it a yellowish pink colour; it unites also very readily with urate of ammonia. For this pigment Dr. Golding Bird proposes the name purpurine; and he conceives it to be identical with what Simon calls uroerythrine, and Heller uroxanthine.*

Fatty Matter.—It may be doubted if oily or fatty matter be ever present in healthy urine. The microscope affords the best means of distinguishing the presence of fatty globules. The film on the surface

* Dr. Parkes, of University College, has stated that the substance termed uroxanthine by Heller, and from which are derived uroglaucin and urrhodin, is in reality, a biliary colouring matter present in the urine, and this statement appears to be confirmed by a late observation of Heller, who found on the mucous membrane of the intestines and in its follicles in persons who died of cholera, blue microscopic crystals identical with this uroglaucin.

of urine which is undergoing decomposition, instead of fatty globules, exhibits, under the microscope, an amorphous granular matter. Cases have occurred in which the urine has contained so large a quantity of fat that the oily vesicles could be observed even with the naked eye, and formed a principal stratum on the surface. It was to fatty urine that Dr. Prout applied the term chylous. According to Dr. Eichholz and Dr. G. Johnson, fatty matter not only exists in abundance in the urine during granular disease of the kidney, but is even pathognomonic of that affection, or at least of one of its most frequent forms.

Salts of the Urine.—Liebig affirms that the incombustible parts of the blood, that is to say its saline matter, when all that is variable or accidental is left out of view, are the same, at all times, and under all circumstances, in all animals. These invariable incombustible substances consist of phosphoric acid combined with potash and soda, and with alkaline earths, lime and magnesia, oxidized iron, and common salt, or chloride of sodium: these same substances are the incombustible matters of the food. If food be withheld, or fails to contain a sufficiency of these incombustible substances, then the same substances fail to appear in the blood. While the body continues in health, and is neither gaining nor losing in weight, these incombustible substances do not accumulate within the living system. The quantity of such matters thrown off equals the quantity which is received into the body within a given time. And there are two principal if not exclusive channels by which these incombustible

substances are thrown off, viz., the intestinal canal and the kidneys. In all animals the blood is alkaline, notwithstanding that it always contains phosphoric acid, the acid being neutralized by an excess of alkali,—for example, of soda. The blood of vegetable feeders contains a much less proportion of phosphoric acid than the blood of carnivorous animals, and yet, as regards the proportion of the incombustible substances present in the flesh of these two orders of animals, there is no perceptible difference. Thus in herbivorous animals a less proportion of phosphoric acid is made to serve the same purpose in the nutrition of the solids as the larger proportion present in the blood of carnivorous animals. While, however, in the blood of vegetable feeders phosphoric acid is present in smaller proportion, carbonic acid is discovered in much larger proportion. And, singular as it may appear, there are many remarkable points of analogy between carbonic and phosphoric acids. Thus phosphoric acid unites with soda without destroying the alkalinity of the compound, as carbonic acid unites with that base, while the compound retains an alkaline reaction. Again, the solution of an alkaline phosphate, like the solution of an alkaline carbonate, can take up a large proportion of carbonic acid, which readily separates from the fluid on agitation or exposure to the atmosphere. And the insoluble earthy phosphates become dissolved in water containing carbonic acid, as happens when an excess of phosphoric acid is present. The urine of man and of carnivorous animals has always an acid reaction, and this property, according to Liebig, depends on the alkaline phosphate of the blood

having been deprived of a portion of its base, by the acids produced from the blood such as the uric. The urine of vegetable feeders has no acid reaction, since the carbonic acid which replaces so large a proportion of the phosphoric acid in their blood, unites with the earthy bases, lime and magnesia. The same author affirms that when the diet of man is exclusively vegetable, carbonic acid replaces a part of the phosphoric acid of the blood, and that on the same condition as in vegetable feeders the urine ceases to be alkaline. He regards the acids which abstract a portion of the base from the phosphates, viz., the sulphuric, the uric, the hippuric, as being the result of a true combustion within the body.

Sulphates.—No fact in chemistry is better established than the existence of sulphur in the blood: nor is its existence less certain in urine. There is, however, this remarkable difference between the two,—in the blood very little sulphur exists in the state of sulphuric acid; while in the fluid derived from the blood and passed by the kidneys, the greater part of the sulphur is found to be oxidated to its maximum—that is, converted into sulphuric acid—and neutralized. The question then arises, whence is the requisite oxygen supplied?

During the circulation of the blood through the lungs, one of the changes there effected is the conversion of part of its carbon into carbonic acid, which is expelled with the breath. In that case, the necessary oxygen being derived from the air in respiration and not by the skin, it might be asked whether at the same time, there may not be a surplus of oxygen gas

taken up and retained in the blood for appropriation in the glands, and particularly in the kidneys? The experiments of Allen and Pepys* ascertained a fact which decides that question. They proved that the whole of the oxygen received by the lungs is again expired, including that portion of it which is formed into gaseous carbonic acid. The oxygen, therefore, for the acidification of sulphur within the kidney, must be derived from the blood itself; and probably from substances contained in it, but of no further use in the animal economy. But the decomposition of these substances, by the abstraction of part of their elementary oxygen, must convert them also into new compounds. In this way, possibly, that highly azotized body, urea, may be formed; for it seems improbable, in a healthy condition of the glands, that a substance of excrementitious character should be created immediately from the albuminous portion of the blood, unless in cases where albumen is formed in excess.

It has been a controverted question, whether urine contains sulphur in any other state than that of sulphuric acid. Berzelius was the first to show that it does, and his experiments led him to conclude that sulphur, iron, and several other substances in the blood exist in some state unknown to us, and certainly not as salts. Engelhart combated the opinion of Berzelius, by showing that these various bodies might be detected without incinerating the blood, provided it were acted upon by chlorine. But the chlorine may liberate oxygen to oxidize the sulphur, iron, &c., by seizing upon the hydrogen of the organic matter, or even of the

* 'Phil. Trans.,' 1807-8-9.

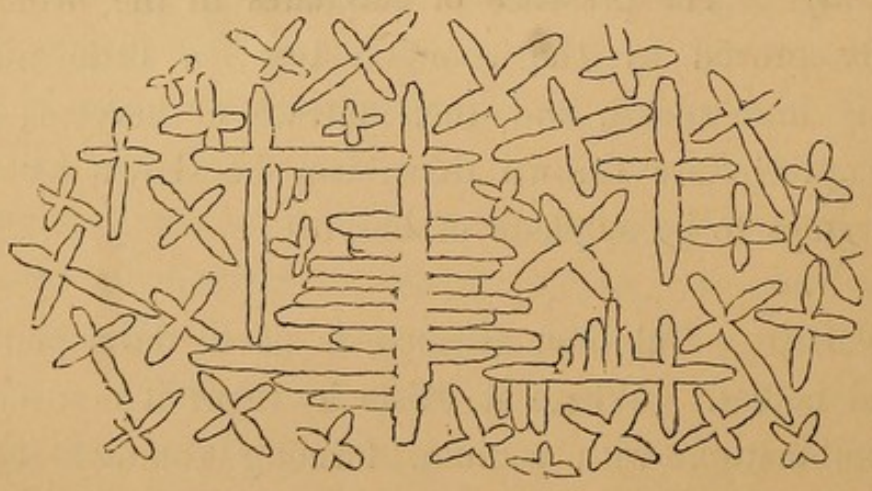
water, and this is so obvious that it is almost a wonder it should have escaped those writers who adopt the views of Engelhart.

In the original analysis of the urine, published by Berzelius, the salts, sulphate of potash, and sulphate of soda, are stated as being present in considerable proportion. In all the more recent analyses, the sulphate of potash is still mentioned as a constituent in nearly the same quantity. The sulphate of soda, however, is commonly omitted, yet in some analyses, for instance in that by Lehmann, alkaline sulphates are set down to the extent of one ninth of the whole solid residue. Whatever doubts, therefore, may be entertained as to the presence of sulphate of soda in normal urine, it is quite certain that sulphate of potash is present in considerable proportion. In some of the analyses, sulphate of lime is also enumerated. The quantity of sulphuric acid present in these salts is plainly greater than could possibly have been introduced into the living system along with the food; it seems clear, then, that a great part of this sulphuric acid arises from the combustion of sulphur within the body. The presence of sulphates in the urine is usually proved by the common test; a little nitric acid is first added, and then nitrate of barytes; the white precipitate thrown down can be shown by the usual steps to be sulphate of barytes.

Chlorides.—Chlorine, as such, is never developed in animal bodies. Where it exists in them it is usually in combination with sodium, forming common salt; but sometimes also, in minute quantities, with potassium,

forming the chloride of that metal. It also exists in union with hydrogen and ammonia, forming common sal-ammoniac. All these neutral combinations are held in solution, and never constitute morbid deposits, because chlorine does not form an insoluble precipitate with lime, magnesia, nor with any other elementary substance present in urine. If, however, free muriatic acid, of which chlorine is an elementary part, be habitually evolved within the stomach, as in dyspepsia, one of the consequences may be the formation of calculi, by the precipitation of the lithic acid, which the urine should retain in solution. Chloride of sodium is easily recognised by its cubic crystals when it can be obtained free from foreign substances; but as it crystallizes from the urine, it usually exhibits very remarkable forms. It has been found that common salt possesses the property, quite unusual among salts, of forming with urea a chemical compound, which crystallizes in beautiful large clear rhombic prisms.

The crystals of chloride of sodium modified by the presence of urea are usually represented as having the form of crosslets and daggers, crenate at the margins.



CRYSTALS OF CHLORIDE OF SODIUM.

Phosphates.—Phosphorus, unlike sulphur, exists only in the state of acid, that is, oxidated to its maximum: at least, it has not been found in any other state in healthy urine. The acid is but partly neutralized by the bases present.

The connexion of phosphorus with the animal economy is interesting, because it forms an essential constituent of the earthy part of bone, fully four fifths of which consist of phosphate of lime. It is the phosphate of lime, too, which, becoming deposited within the bladder, forms one species of urinary calculi. There is another urinary calculus in which the phosphoric acid is combined with magnesia and ammonia, usually called the triple phosphate; and sometimes both these phosphates are present in the same stone, constituting a third species, denominated the fusible calculus. The formation of these particular deposits is attributed to a deficiency of free acid in the urine.

In Berzelius's analysis, the phosphate of soda, the biphosphate of ammonia, the phosphate of lime, and the phosphate of magnesia are enumerated. In some of the more recent analyses of the urine, the phosphate of ammonia is omitted. Dumeril, however, mentions the phosphate, and Marchand the biphosphate of ammonia. When free ammonia is added to fresh urine earthy phosphates are immediately deposited, and when lime water is added to this urine, after the earthy phosphates have been removed by filtration, phosphate of lime derived from the alkaline phosphates is precipitated. The alkaline phosphates are freely soluble in water, the earthy phosphates are insoluble in water, unless there is an excess of phosphoric acid. The earthy

phosphates, however, are soluble, when certain acids are present in the water, for instance the nitric, the hydrochloric, the acetic, and the lactic; and hence, when free acid is present in the urine, the earthy phosphates remain dissolved.

The phosphates of soda are more abundant in the urine than the earthy phosphates, which as regards quantity are of much less importance. Hence as to quantity, if we speak of phosphates in the urine, we ought to limit that term to the alkaline phosphates, and not apply it to the earthy phosphates alone. The amount of earthy phosphates precipitated when the urine becomes alkaline is solely dependent on the amount of the earths present; that is, on the quantity of lime and magnesia passing out of the system.

Dr. Bence Jones arrives at the following conclusions on this subject:

1. The variations of the earthy phosphates are so dependent on the earthy matter (lime and magnesia) present in the urine, that no deduction from them as to the nature or state of the disease is possible.

2. Neither the earthy phosphates nor the alkaline phosphates are permanently increased in spinal diseases.

3. In fevers and acute inflammations of fibrous, muscular, or cartilaginous tissues, the total amount of earthy and alkaline matter is not increased.

4. In chronic diseases in which the nervous tissue is not affected, no deduction can be drawn.

5. Chronic cases of mania, melancholia, and general paralysis of the insane, give no marked results.

6. In chronic diseases of the brain, and in chronic

or even acute disease of its membranes, there is no increase in the total amount of earthy and alkaline phosphates.

7. In fractures of the skull, when any inflammation of the brain comes on, there is an increase of the total amount of phosphates. When there are no head symptoms, no increase of the phosphates is observed, even when other acute inflammations supervene.

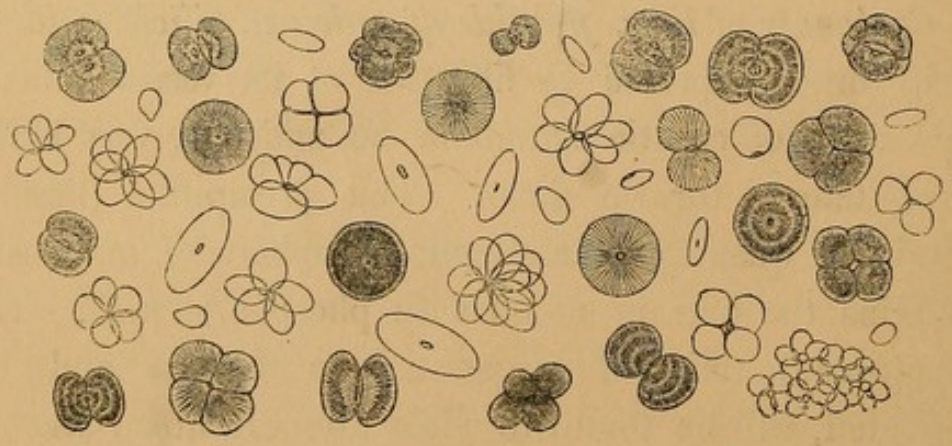
8. In acute inflammation of the brain, there is an excessive amount of phosphates in the urine. When the inflammation becomes chronic, no excess of phosphates can be shown to exist by the method of analysis employed.

9. In some functional diseases of the brain an excessive amount of phosphates is observable: this ceases with the delirium. Delirium tremens shows a remarkable deficiency in the amount of phosphates excreted, provided no food is taken. When food can be taken the diminution is not apparent.

Carbonate of lime, fluoride of calcium, silicic acid.— If to urine, deprived by filtration of its vesical mucus, an excess of caustic ammonia be added, a very bulky precipitate is thrown down. This precipitate (besides a minute quantity of ammonio-phosphate of magnesia) contains the lime in union with phosphoric acid. The supernatant fluid, if evaporated to dryness and incinerated, will be found to yield no more lime; whence it is obvious that if, according to Berzelius's experiment, calcium exists in blood in some other state than lime, this metallic base must become oxidated during its excretion by the kidney. Lime is a principal con-

stituent of several kinds of urinary calculi, two of which have been already mentioned. There is a third, the oxalate of lime, or mulberry calculus. Where it does not result from the peculiar character of the food, the cause of this morbid deposit is the formation of oxalic acid in the living body; possibly from some undue oxidation of carbon within the kidney. So strong is the affinity between lime and oxalic acid, and so great the insolubility of the resulting compound, that the addition of a very minute quantity of oxalic acid occasions in the urine a precipitate of oxalate of lime; because the oxalate, unlike the phosphate of this earth, is not (or at least not to the same extent) soluble in the natural acid of the secreted fluid.

Carbonate of lime, may occur, according to Liebig, in normal urine, when the diet of man is confined to certain vegetable substances. A trace of fluoride of calcium has been detected by most chemists in their analyses of the urine. The same may be said of silicic

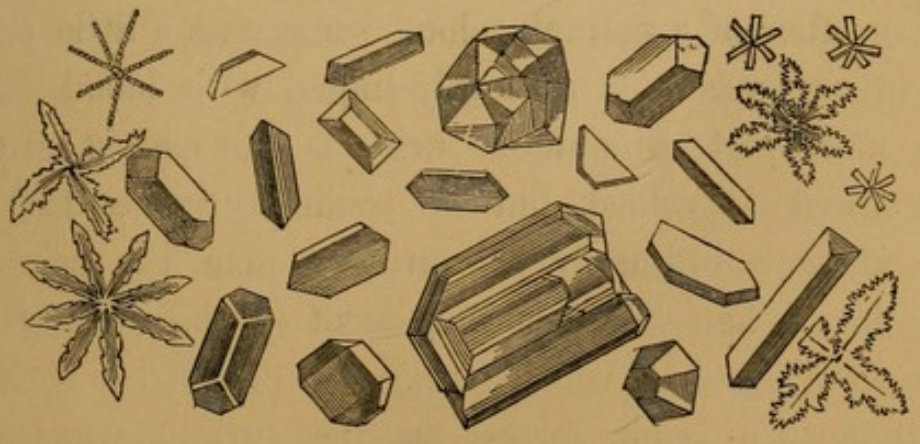


CRYSTALS OF CARBONATE OF LIME.

acid. In the majority of cases, carbonate of lime forms an amorphous deposit, mixed with prisms of ammoniaco-

magnesian phosphate. More rarely, it is met with regularly crystallized, in compound spherical crystals, like close-packed needles radiating from a common centre.

Magnesia.—The proportion of this earth found in urine is small; it is precipitable in the state of ammonio-phosphate, along with the phosphate of lime, on the addition of ammonia. A portion, however, of the magnesia remains some time longer in solution; such is the case when the carbonate of ammonia is employed. If, therefore, immediately after the addition of this reagent, the fluid be filtered, and then allowed to remain two or three days, there will form a few sparkling crystals of the ammonio-phosphate of magnesia. After removal of the crystals from the solution, no more magnesia can be discovered by evaporation and incineration. No magnesium, therefore, exists in urine, except in an oxidized state. Magnesia, like lime, in combination with phosphoric acid, is one of the con-



TRIPLE PHOSPHATE CRYSTALS.

stituents of bone earth; but it forms a very small part. As before stated, it is also a principal ingredient of

certain urinary calculi. These are the triple phosphate, or ammonio-phosphate of magnesia; and the fusible calculus, consisting of that salt and the phosphate of lime. The triple phosphate presents various appearances under the microscope, some of the crystals being triangular and quadrilateral prisms, others stellated or penniform.

ABNORMAL STATES OF THE URINE.

Having thus briefly considered the urine in its healthy state, and noticed some changes to which it is liable, I pass to the consideration of its chief abnormal conditions; and first of

Albuminous Urine.—Healthy urine does not contain albumen, being coagulable neither by heat nor by acids. Albuminous urine contains much less urea than healthy urine, and it is with this state of the urine that urea is found in the blood. It is not characterised by any particular physical appearance; being often of a natural colour, sometimes a little pale; at other times it is obviously tinged with blood. For the most part, albuminous urine is transparent at the instant it is voided, but on cooling becomes turbid; its odour is ordinarily less urinous than the urine of health. When albumen is present in the urine, there are many tests by which it may be detected. If it is abundant, a scum forms on the surface when the urine is heated; and most strong acids cause the albumen to coagulate. The common tests, however, of albumen in the urine are heat and nitric

acid; for if a few drops of nitric acid be added to urine containing albumen, a precipitate is formed, which we cannot re-dissolve by an excess of the acid, but which is readily dissolved by the addition of a sufficient quantity of an alkali. Heat, from its property of quickly coagulating albumen, is an excellent test for recognising this substance, as it has the advantage of not coagulating the other elements of urine. Albuminous urine, on being exposed to a temperature of about 150°, becomes opaque, and deposits the albumen in a coagulated state. The precipitate varies considerably in appearance in different instances, being sometimes firm, and similar to that formed by the serum of the blood, from which it may then be supposed to be derived; while, at other times, it is delicate, fragile, and somewhat resembling curd, when it may be considered to be of chylous origin. When the quantity of albumen present is not very abundant, some nicety is required in the application of these tests to obtain a correct result. Thus heat sometimes causes a milkiness of the urine in consequence of a deposit of earthy phosphates; this milkiness, however, is removed by a drop of nitric acid. If nitric acid be used alone in too large a quantity, it may redissolve the compound which the first portion of it formed with the albumen. Again, it is found that the presence of a small proportion of acid prevents the effect of heat in the coagulation of the albumen: also if urea be present in unusual abundance, the addition of nitric acid might at once cause a precipitate by the formation of nitrate of urea; in other cases the addition of nitric acid might cause a precipitation of urate of ammonia.

These sources of fallacy, however, are for the most part easily avoided. If heat causes a deposit in urine which is not removed by a drop or two of nitric acid, it is almost certain that albumen is present. Dr. Bence Jones says, "for quickness I generally try nitric acid first. If no precipitate falls or forms on standing for a few seconds, I decide against the presence of albumen. If there be a precipitate, I boil the same acidulated specimens of urine. If the precipitate be permanent on boiling, I consider the presence of albumen highly probable. Before deciding, I clean the tube and boil the urine first, and then add a drop or two of nitric acid. The object of cleaning the tube is to free it perfectly from acid, for a small quantity of acid hinders the coagulation of albumen by heat. * * * * I have many times known an unclean test-tube, containing merely a trace of strong acid, lead to the assertion that urine contained no albumen, when a very considerable quantity really was present. * * * Instead of filling the test-tube with urine, it is well to take about a drachm of urine, filtered, if it be not previously quite clear; that is, if any cloudiness at all is perceptible, the urine ought to be first filtered; then the clear liquid should be boiled for a minute, and afterwards two drops of nitric acid should be added." When albuminous urine is alkaline, it is sometimes incapable of being coagulated by heat.

In the next place, it is of much importance to determine under what circumstances albumen has appeared in the urine. For this purpose the aid of the microscope is requisite. Albumen may co-exist in the urine with blood-globules, fibrine-globules, and pus-

globules, and none of these can easily be distinguished except by the microscope. If a portion of the urine, determined to contain albumen, be left at rest for twelve hours, sometimes a distinct line of red globules is discovered at the bottom of the vessel. This, however, happens only when the quantity of blood-globules is considerable. It is an important fact that blood-globules are hardly ever discovered in the urine, except when albumen can be detected in it by heat and nitric acid. The co-existence of fibrine with albumen in the urine cannot be discovered except by the microscope. When the fibrine assumes the form of the urinary ducts of the kidney, albumen being at the same time present with or without blood-globules, we have a certain indication of congestion of the cortical structure of the kidneys, most probably connected with Bright's disease, or as a sequel to scarlet fever. When blood-globules are found without fibrinous casts, the change more probably depends on the presence of a calculus in the bladder or some part of the urinary passages, and this conjecture will be confirmed, if crystals of uric acid or oxalate of lime be discovered at the same time. When pus-globules are met with in the urine along with albumen, suppurative inflammation is certainly going on. If the fluid contains fibrinous moulds likewise, the inflammation is probably seated in the kidney, and is connected with Bright's disease. If no fibrinous moulds can be detected, it is not unlikely that a calculus has produced suppurative inflammation in some part of the mucous membrane. Fibrinous moulds, blood-globules, pus-globules, albumen, and crystalline deposits may all

be discovered at the same time in the urine, and then it may be predicted that degeneration of the kidney, inflammation, and calculus will be discovered after death.*

It has been well remarked that the presence or absence of albumen in the urine is a sign of the greatest importance, because, as a general rule, if it be not found, neither fibrine, pus, nor blood can be present.

Pus.—The existence of pus in the urine, to which I shall more fully allude hereafter, indicates suppuration at some part of the urinary canals. Pus must be distinguished from mucus. In pus-globules active nuclei are almost always to be found; that is, young pus-cells growing within the old ones. Mucus does not multiply; the cell is only slightly granular. With mucous exudation, globules do not occur; with pus they are constantly found.

Blood is often poured out in abundance from the mucous membrane lining the urinary passages, and is generally diffused through the urine, or is passed in clots. In other cases small quantities of blood are passed, mixed with pus or mucus, or alone, after the urine has been voided. When large quantities of blood are voided, especially without pain, it is probably a simple exudation from some part of the mucous surface of the urinary organs; on the other hand, when the blood is mixed with pus or mucus, and passed with pain, ulceration of the kidney or bladder is indicated, and the

* Dr. Bence Jones, op. cit.

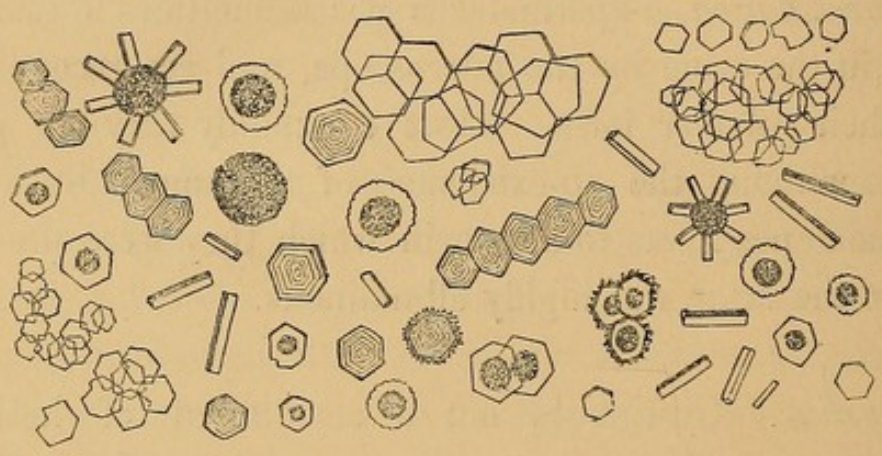
hæmaturia may be combined with the existence of a foreign body in the bladder.

Dr. Willis, and other writers, quote several authorities to show that hæmaturia is endemic in some countries.

Spermatozoa.—Spermatozoa are sometimes discoverable in the urine by the microscope, and are recognised by their peculiar form. Most commonly they are present without the co-existence of albumen, but Dr. Bence Jones refers to a case in which they were present while the urine was highly albuminous.

Cystine.—Cystine is not a constituent of healthy urine, nor is it often found in the diseased secretion. It was first discovered by Dr. Wollaston in a calculus given to him by Dr. Reeve of Norwich. Its chemical composition is remarkable; besides the common elements of organic animal bodies, carbon, hydrogen, nitrogen, oxygen, it contains so large a proportion of sulphur as twenty-six per cent. It has not been recognised till lately as a constituent of morbid urine. It forms a nearly white or pale fawn-coloured pulverulent deposit, much resembling the pale variety of urate of ammonia. The urine which contains it, when first passed, is commonly turbid, and after a time deposits the cystine. Pure cystine is dissolved by the mineral acids, and forms with them saline combinations. It is easily dissolved by ammonia, but is insoluble in the solution of carbonate of ammonia; it is dissolved, however, by solutions of the fixed alkalies, as well as of their carbonates; when heated on platinum foil it burns while

it evolves a disagreeable smell. The microscopic characters of cystine are so striking and peculiar as to render the use of tests unnecessary. The hexagonal plates are beautifully shown when the solution in ammonia is allowed to evaporate spontaneously.



MICROSCOPIC APPEARANCES OF CYSTINE.

Uric oxide, or xanthic oxide.—Uric oxide, or xanthic oxide, has also been termed xanthine, and urous acid. It was first discovered by Dr. Marcet in a minute calculus composed entirely of this substance. But to uric oxide, a substance obtained from guano, termed guanine, is closely allied; also the substance which Scherer has termed hypoxanthine. Uric oxide dissolves slowly in nitric acid, and the solution on evaporation leaves a yellow residue.

Kiestein.—Some years ago Nauche announced the discovery of a peculiar substance in the urine of pregnant women to which he gave the name of kiestein, and which he regards as an indubitable sign of pregnancy. Many chemists have applied themselves to the

investigation of this subject, but some uncertainty still surrounds it. It is, however, probable that kiestein is nothing but a small quantity of fatty matter mixed with phosphates, and that it is not peculiar to pregnancy.

Sugar.—In healthy urine no sugar is found. Sugar, however, is plainly formed from starch in the process of digestion, and is well known to be abundant in at least one healthy secretion, viz. the human milk. The sugar of milk is not exactly the same as the sugar of morbid urine, but does not differ very much from it in chemical constitution. In the process of digestion, starch appears to pass under the influence of the hydrochloric acid of the gastric juice into dextrine, and subsequently the dextrine into sugar. The sugar found in morbid urine is the same as that derived from grapes, to which chemists have applied the name of grape sugar. Hitherto sugar has been met with chiefly in diabetes, and is regarded as a sign of true diabetes, although it is sometimes found in small quantities in persons who are not diabetic; in the latter case, however, its presence is only temporary, and the quantity so small as not to affect the specific gravity. It seems not impossible that sugar should sometimes be present in derangements of a less serious character, though its presence in a considerable quantity in any other affection besides diabetes has not yet been ascertained. Bernard has stated, that if a certain spot in the fourth ventricle of the brain of rabbits be pricked, the urine and the blood will contain large quantities of sugar in the course of an hour or two; but this observation has not been confirmed.

Numerous tests of sugar in the urine have been suggested of late years.

It may often be obtained in crystals by evaporating the urine to the consistence of an extract and digesting this extract with alcohol, on the evaporation of which the crystals form. A convenient test is that proposed by Mr. Moore of Birmingham. Two drachms of the suspected urine are placed in a test tube, and a drachm of liquor potassæ is added. The mixture is heated till it boils; if sugar be present, the urine, which was previously pale, becomes of an orange brown, or even of a bistre tint, according to the proportion of sugar present. The solution of potash must be free from lead, otherwise a dark colour may be produced though no sugar is present.

The copper tests, however, of Trommer and of Capezzuoli are more perfect. They consist in adding to the suspected urine a solution of sulphate of copper, or of the blue hydrated oxide, the mixture being rendered alkaline by the liquor potassæ. In the one case we have a blue solution, and on boiling the mixture a deposit of red suboxide of copper if sugar be present; and in the other a reddish solution which in a few hours becomes yellow.

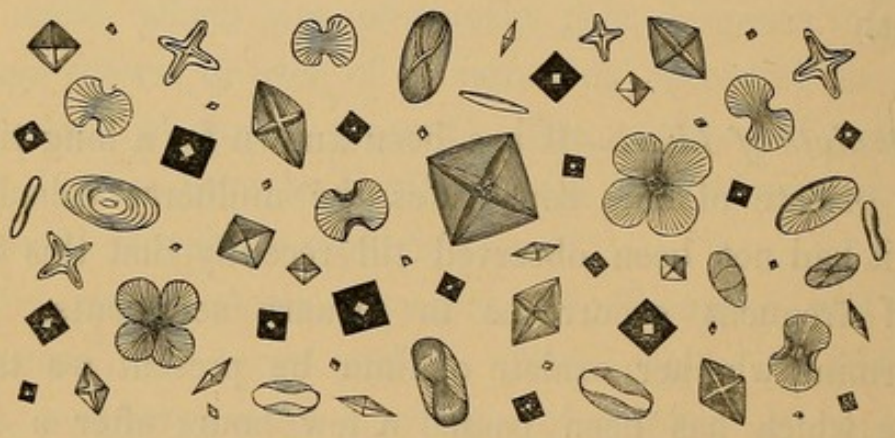
The most convenient means of ascertaining the presence of saccharine matter in diabetic urine is to add to it some yeast, which gives rise to vinous fermentation,—a most delicate test, as it can detect one part of sugar in a thousand parts of urine. Every cubic inch of gas given off nearly corresponds in round numbers to one grain of sugar—47 of gas to 45 of sugar. This process, although simple of execution, requires

certain precautions in order to avoid an erroneous result, as the yeast sometimes contains a small quantity of saccharine matter, which is decomposed during the fermentation, and might lead to the supposition that sugar existed in the urine although none was present But the quantity of carbonic acid gas given off by the yeast is always very small. On the other hand, if the temperature to which the liquid is exposed be too high or too low, fermentation may then not take place, although the proportion of saccharine matter may be sufficiently great.

Oxalate of Lime.—It has been known for a long time that oxalate of lime constitutes the mulberry calculus, but it had not been observed till recently that this salt is of frequent occurrence in urinary sediments. To determine whether oxalate of lime be present we take urine which has been passed a few hours after a full meal; a portion of the fluid is placed in a large test-tube, and allowed to stand for some hours. The upper six sevenths are decanted, a portion of the remainder is then poured into a watch-glass and gently warmed over a lamp; the fluid is allowed to repose for a minute or two, and then the chief part of it is removed with a pipette and replaced by distilled water. A white powder, often of a glistening appearance, will now become visible, and this, under a microscope, exhibits crystals of oxalate of lime in beautifully formed transparent octohedra, with sharply defined edges and angles, and other forms usually termed dumb-bells.

Urine containing a considerable quantity of the crystals of oxalate of lime presents the following cha-

racters. It is strongly acid, of an amber or greenish yellow hue, perfectly transparent, and high specific gravity; it contains an excess of urea, readily crystallizing on the addition of nitric acid: when heated it exhales a peculiar aromatic odour, resembling the sweet briar. Epithelium scales are sometimes present in the urine, which is then more or less turbid. If the urine be held up to the light, minute shining points may often be seen diffused through the fluid.



CRYSTALS OF OXALATE OF LIME.

Lehmann, Höfle, and other chemists, have shown that oxalate of lime always exists in the normal urine of herbivorous animals, and not unfrequently in the normal urine of man. The presence of oxalate of lime in the urinary secretion has been supposed to indicate the presence of a peculiar morbid diathesis to which the name of oxaluria has been applied. There can be no doubt that the presence of this salt in the urine has frequently been connected with great derangement of health; and it is equally certain that oxalate of lime may be found in the urine when no derangement exists; but we also know that it may

be detected in the urine, in considerable quantities, when the derangements of the health for which relief is sought are of the most dissimilar kinds. The question then arises, what indications can be drawn from the presence of oxalate of lime in the urine? To answer this question correctly, we must distinguish those cases in which the salt occurs temporarily, from those in which the urine is constantly charged with it. Examples are not wanting. Thus, we may suppose that a dozen healthy men dine together; they eat a large quantity of rich food, and drink abundantly of sparkling wines or bottled ales. On the following day the urine passed by several of these persons will be found to contain oxalate of lime. But let the same persons live abstemiously for the next twenty-four hours, and the crystals of the oxalate will have disappeared. The deviation from the normal state of the urine was, here, only temporary, and the cause evidently connected with imperfect assimilation.

An individual is exposed to cold and wet, and is attacked by rheumatism. Urate of ammonia is thrown off by the kidneys in large quantities, and amid its amorphous granules, crystals of oxalate of lime are found. Now, whether in this case the oxalate results from a change in the elements of urine—a change effected subsequently to its exit from the kidney, or whether it be, as in the former case, directly formed from the diseased blood, may admit of question; a question, however, to be decided by chemists, and not by those engaged in the practice of their profession. Still this much the practitioner knows, that in these cases its presence is temporary, and that practically it is of no

value as an element in determining on the result of the case.

How different from either of these cases is that of a man whose every look, whose every movement indicates mental depression. His complexion is dingy, or of a greenish yellow tint. He fancies himself the subject of every ailment that flesh is heir to; now cancer, then phthisis; now threatening apoplexy, and then coming insanity. He cares no more for the pleasures of the world, and in mental exertion he has ceased to find joy. If he consults a medical man, and the urine is examined, it is found of high specific gravity, acid, and in it crystals of oxalate of lime may be detected; but here they are discovered in considerable quantity, not only for a day, but for weeks and months, unless the patient be judiciously and successfully treated. On inquiry, in such a case, as Dr. Golding Bird has remarked, the sexual power is generally found defective. What is the primary disease in the case just alluded to? Disordered digestion and malassimilation; — and to correct these deviations from healthy action, the treatment must be directed. The presence of oxalate of lime in the urine is here a symptom; but then it is a symptom of great value both with reference to diagnosis and to prognosis. Experience has taught us, that, although the patient may complain but little of dyspeptic symptoms, yet the process of digestion is imperfectly effected; we know, moreover, that the disease, although it may be cured with difficulty and be liable to recur, will be rendered comparatively harmless by the administration of judicious remedies, attention to hygiene, and proper regimen. The warn-

ing afforded by the presence of oxalate of lime in the urine in such a case must not be neglected, or most serious consequences may ensue.

I will suppose another case. A man has had repeated attacks of winter cough — of bronchitis, followed by pulmonary emphysema; his breathing is always more or less impeded; he is, to use a common expression, short-breathed. Now in the urine of this man, according to Lehmann, much oxalate of lime will be frequently discovered.

The local action of the salt on the bladder, and its influence in exciting an irritable state of that organ must not be overlooked. Urine charged with oxalate of lime is apt to produce irritability of the bladder, whatever may be the cause of the formation of the salt; and hence the necessity of our carefully examining into the condition of the urine in all cases of vesical irritation. Irritability of the bladder is merely a symptom, the removal of which we cannot expect to attain, unless we remove its cause. The practitioner must also bear in mind that the presence of oxalate of lime in the urine of patients labouring under acute diseases is often indicative of the commencement of convalescence. Dr. Walshe, of University College, has settled this point, and has published very satisfactory tables in illustration. In 17 out of 19 acute and anæmic cases, crystals of oxalate of lime appeared in the urine at the commencement of recovery; and, as he remarks, their deposit may be regarded as the indication that convalescence approaches.

The treatment of cases in which oxalate of lime is detected in urine must vary with the cause of its

origin. If it occur during the course of, or convalescence from, an acute disease, the treatment must be altogether directed to the relief of the disease itself, and conducted without reference to the presence of the salt; if it have its origin in the imperfect performance of the respiratory function, its presence must be regarded as of very trifling moment. The remedies indicated are those which improve the disease of the lung, so that by removing or alleviating the primary disease, one symptom—the oxalate of lime—may also be removed. Should the presence of the salt arise from errors of diet, these must be corrected,—abstinence practised, a gentle aperient administered, and the cure will be effected. In those cases in which the oxalate is the consequence of chronic dyspepsia, it is the stomach affection chiefly which is to be treated. Daily exercise, if possible, should be enjoined, and the patient should wear light warm clothing. The amount of exertion must be such as to induce a very slight sense of fatigue. The food should be simple and not stimulating; plainly cooked mutton and beef, with a moderate quantity of farinaceous or leguminous vegetables, should form the chief meal to be taken in the middle of the day. For breakfast, cocoa made by boiling the nibs with a considerable proportion of the milk left after the removal of the cream should be the drink, a lightly boiled egg and dry toast the solids. Green tea is rigidly to be excluded from the patient's diet list. A little arrow-root made with milk and water, and dry toast should form the supper, to be taken about half an hour before retiring to bed. Early rising is an advantageous rule, and the patient should, if possible,

be asleep before eleven at night. Mental repose is essential for the well-doing of these often obstinate cases. Change of scene, by distracting the attention, and change of air, by invigorating the general system, exert a marked influence over the digestive organs. Stimulating drinks are to be avoided, the most to be allowed being a little weak brandy and water at dinner. As to medicines, the bowels must be regulated by gentle aperients; aloetics with tonics are perhaps the best, and for this purpose the extracts of gentian and aloes form a good compound. Should the colour of the stools indicate a sluggish action of the liver, then a mild mercurial may be given two or three times a week for a fortnight or three weeks. In some cases a chalybeate proves useful; the indication for the use of iron being the anæmic condition of the patient. Hydrocyanic acid in full doses often affords considerable relief. Narcotics should be avoided, the irritable state of the patient too often leading to their injudicious administration. Nitro-hydrochloric acid, is sometimes of considerable service, as is also nitric acid. With reference to the nitro-hydrochloric acid, Dr. Golding Bird says, "they—that is the nitric and hydrochloric acids — should always be prescribed in the proportion of one part nitric and two or three of hydrochloric acid, with a direction for them to remain together at least a few minutes before being diluted to the proper extent for administration in medicine."

As a due performance of the function of the skin is essential for the healthy exercise of the digestive powers, tepid baths should be taken two or three times a week, either in the form of plunging or shower baths; the

skin immediately after being well rubbed with a coarse towel. Some patients derive benefit from cold shower baths, the test of their agreeing being the glow fell quickly after leaving them. If the patient feel chilly for some time after the bath, the surgeon must forbid its further employment.

CHAPTER II.

IRRITABILITY OF THE BLADDER.

The term irritability of the bladder is usually employed to denote any affection attended with frequent desire to void urine. The complaint may arise as a consequence of organic disease of the kidney, bladder, or prostate, or it may be merely functional, that is, unconnected with inflammation or disease of the urinary organs, but depending on functional derangement of the bladder, or disorder of the kidneys, or on nervous affections of a remote and constitutional origin. It is to this latter form of irritable bladder, essentially functional in its nature, that the following observations, are intended to apply.

The frequent desire to micturate is the chief symptom of this complaint. Thus, a person previously enjoying good health, feels suddenly a desire to void urine every half-hour, or oftener; and the desire is so strong, that, unless he yield to it at once, the urine passes in spite of all attempts to prevent it; or, if he succeed in checking the desire, uneasiness, pain, or even paralysis of the bladder are apt to occur. In this disease micturition is sometimes, but not always,

attended with pain in the glans, or under the frænum, and with violent efforts or straining.

The urine, except in hysterical subjects, is voided in small quantities; and although such quantities are passed frequently, their aggregate does not much exceed that discharged by a person in health.

Hysterical persons sometimes suffer from irritable bladder, and great pain may also be experienced in passing urine. In these patients, the quantity of urine is often considerable, and it possesses the aqueous character, or contains less than the usual proportion of solid matter, the nature or relative quantity of its constituents remaining the same. This peculiarity in the quantity and quality of the urine is capable of explanation perhaps, to a certain degree, from the fact that the viscera apt to be deranged in hysteria all derive nerves from the same source, namely, the abdominal ganglionic system.

Opportunities for examining, after death, the bladders of persons who laboured under idiopathic irritation of this organ, are exceedingly rare. I examined the body of a gentleman, of very nervous temperament, who having long been a sufferer from this affection, was carried off by disease of the lungs, but I could not detect the least alteration in the appearance or structure of the bladder, or of any of the urinary organs.

Still after long-continued irritation, the bladder often diminishes in size; and, instead of containing a pint or more, is incapable of holding above two or three ounces. Notwithstanding this contracted state, if there be no stricture or disease of the prostate, the parietes of the organ are often thinner than natural. It would,

therefore, seem that long-continued irritation may produce actual absorption of part of the substance of the bladder.

Where a case of irritability of the bladder comes under the notice of the surgeon, the first and great object of inquiry is, the cause on which the irritation depends. It may arise from pressure of the womb during pregnancy, hardened fæces, hemorrhoids, or foreign bodies in the bladder. In almost all cases of stricture, the bladder is liable to irritation; but, in all these cases, if there be no alteration in the structure of the organ, the irritation subsides when the cause is removed. After the operation for stone, also, the bladder often remains irritable.

The slightest derangement in the digestive organs, by disturbing the functions of the kidney, may cause irritability of the bladder. Adults, and children more particularly, are very liable to this affection in the summer season, from eating fruit. In these cases, the urine contains an excess either of uric acid or of urate of ammonia; and we are further to recollect that the malic, citric, and other vegetable acids, are conveyed to, and excreted by, the urinary organs, unchanged by any process of digestion or sanguinification.

The most common cause of irritable bladder is a morbid condition of the urine. It rarely happens that this viscus, when free from organic disease or changes of structure dependent upon stricture of the urethra, is unable to retain healthy constituted urine, which acts as the natural stimulus to its mucous membrane. This opinion was entertained by Dr. Prout, who remarked, "Cases of irritable bladder depending on functional

derangement of the kidneys usually result from the unnatural properties of the urine. All deviation from the normal condition of the urine, whether in deficiency, in excess, or in kind, are recognised by the containing organs, and may prove a source of irritation in the kidneys and bladder. Hence, whenever the urine is very dilute or very concentrated, or is preternaturally acid or alkaline, or contains any unnatural ingredient, the urinary organs in general, and the bladder in particular, though perfectly healthy, are liable to become excited and irritable, and the individual has no peace till the unnatural secretion is discharged. In such cases the fault lies, not in the bladder, but remotely in the kidneys and assimilating organs."*

Sometimes irritation is produced by taking alkaline remedies for too long a time; and, in such case, the urine becomes alkaline. I was consulted for irritability of the bladder by a gentleman whose urine was alkaline, but whose appearance and state of constitution did not lead me to expect this state of the secretion. On inquiry, I found that he had been in the constant habit of taking the sesquicarbonate of soda in large doses. I ordered him to discontinue its use, and he soon recovered. As the altered state of the urine is often the immediate cause of irritability, it should especially engage our attention. In other cases, the disease will be found to depend on the abuse of diuretic remedies, or the excessive stimulus of certain irritant substances, as cantharides, &c.

Many gouty and rheumatic persons are subject to this complaint. It often occurs, that a patient with irritable

* 'On Stomach and Renal Diseases,' p. 366.

bladder applies to his medical man, who, on inquiry, finds him occasionally subject to pains in the limbs and loins, to some scaly eruption on the skin, and sickness of a morning; the urine is usually passed in small quantities, is very acid, and contains a large quantity of the urate of ammonia.

The following case illustrates this common form of the disease:—A gentleman, forty-two years of age, and subject to rheumatism, applied to me on account of a very frequent desire to pass urine, from the annoyance of which he had for several years suffered. He was affected with a scaly eruption on several parts of the body, particularly about the elbows and knees; and he often felt severe pains in the hips and loins. The urine was very acid and scanty. I ordered him a mixture of diosma, henbane, carbonate of potash, and sarsaparilla. I gave also blue pill and rhubarb at bed-time. After some time, the irritability of the bladder was much lessened, and the character of the eruption improved. I then gave the decoction of the pareira brava during the day, with a grain of the acetous extract of colchicum at bed-time. His complaint was much relieved but not cured.

Great irritability of the bladder and urethra, with increased secretion from the mucous memcrane of these parts, is frequent with some persons shortly before a fit of gout. The disease assumes the character of gonorrhœa, and is attended by pain and scalding in making water, the calls to perform which act are frequent and urgent. These symptoms of irritability of the bladder are more likely to occur when the urethra is affected with stricture.

"During the most frequent symptoms of the paroxysm," says Sir C. Scudamore,* "the urine is usually passed with considerable irritation, both as to frequency and sense of heat. The pink or lateritious sediment appears, more or less, in every portion of the urine, during the inflammatory symptoms. When these have entirely subsided, and the state of the liver (on the condition of which the symptom in question principally depends) still remains unhealthy, the sediment of the urine often assumes a whitish colour, and is compared by the patient to the appearance of magnesia. This and the pink sediment frequently alternate, one or the other appearing as inflammatory or nervous action most prevails. Sometimes, however, it occurs that a patient who has for years been labouring under irritability of the bladder will have this symptom relieved or suspended during a paroxysm of the gout." The lateritious sediment is composed of urate of ammonia tinged with the yellow colouring matter of the urine, and occasionally by the purpurate of ammonia, the latter indicating chronic disease of some of the abdominal viscera, and especially the liver. The white sediment is the urate of soda, which, in certain gouty constitutions, is apt to be deposited in an amorphous form, rendering the urine of a milky colour. "I have seen it," says Dr. Prout,† "copiously secreted, of the consistence of mortar, especially during the night, and in this case it is apt to collect into masses and to block up the urethra."

* 'On Gout and Rheumatism,' p. 18.

† 'On Stomach and Renal Diseases,' p. 196.

In certain individuals the nervous system appears to have undergone a peculiar modification, which manifests itself by spasmodic or nervous twitchings of the muscles in different parts of the body. The bladder, as well as other organs, appears to suffer the influence of this constitutional state; and the irritability thus produced is often kept up by habit, or may be brought into action by grief, anxiety, and other mental affections of a depressing nature.

The irritation produced by disorder in some neighbouring organ is an obvious and intelligible cause of the complaint. Thus, the presence of scybala in the intestines may give rise to it. I have already assigned a reason why sympathy should exist between the bladder and other pelvic viscera, by which the diseases of the former may be mistaken for those of the latter or *vice versa;* but sympathy is not confined to these, for if certain parts of the primæ viæ, as the stomach, the ileum, often the colon, and still oftener the rectum, be the seat of irritation, sensations are produced in the bladder, the perineum, or urethra, which fill the mind of the sufferer with serious apprehensions as to the result.

I have known irritation supervene on paralysis of the bladder. A gentleman, during an attack of typhus fever, was seized with inability to pass urine. It was drawn off twice a day. As he gained strength the power of micturating returned, and the desire to pass it then became so frequent as to compel him to do so every half hour. He consulted me for this symptom. There was no disease in the urinary organs, and, with

the exception of occasional rheumatic attacks, his general health was good. The urine was very acid and scanty. I ordered him a grain of the acetous extract of colchicum at night, and ten grains of bicarbonate of potash, seven of sesquicarbonate of soda, and four of nitrate of potash twice or three times a day, soon after meals. By these means the urine became more abundant and less acid; but frequent micturition continued. I tried the infusion of diosma, the decoction of the pareira brava, and various preparations of steel, for the relief of this annoying symptom, but without success.

I have known a contracted state of the prepuce cause irritability of the bladder in children. A striking case of this kind occurred to me some time ago:— The boy, seven years of age, had for the previous eight months, complained of a frequent desire to make water, attended with difficulty in passing it, and pains round the lower part of the abdomen. On examining the prepuce, I found it so contracted as scarcely to admit the point of a probe. I immediately removed the end of the prepuce by circumcision. From that time the symptoms subsided, and the child recovered. Again, a boy, eleven years of age, had suffered during two or three years from pain in making water and incontinence during the night. He became my patient. I found the prepuce as contracted as in the previous case. Simple division was had recourse to, and all symptoms vanished. In these cases, the division or removal of the extremity of the prepuce suffices for the cure of the complaint.

Irritability of the bladder is not uncommon in chil-

dren, especially at the period of dentition. We may infer in many of these cases that there exists something unnatural in the composition of the urine, although chemical analysis may not at all times succeed in detecting it. Spasmodic action of the bladder may also have some share in producing this form of the disease; for we know that the irritation of teething is often propagated to distant muscles. Considerable perseverance may be required on the part of the patient to overcome this troublesome complaint, especially if an involuntary discharge of urine occurs, as it commonly does, during sleep.

A morbid desire to empty the bladder is a frequent symptom concomitant with the development of malignant disease in the prostate gland and adjacent parts. This subject, however, will not be considered in the present chapter further than to remark that in investigating a case, the possibility of the existence of such disease should be present in the mind of the surgeon.

When the amount of urine secreted by the kidneys during the twenty-four hours is greatly increased, as in diabetes, for example, a patient, overlooking the real nature of the case, may imagine, from the frequent calls to make water, that he is suffering from irritable bladder. Hence accurate inquiries should always be made as to the amount of urine voided upon each occasion, and the aggregate amount passed in the twenty-four hours. The analysis of the urine is indispensable.

Irritability of the bladder may, in many cases, be mistaken for an inflammatory affection of the organ.

The distinction, however, is easy, and of great practical importance. If the disease has recently occurred, it may be distinguished from acute inflammation of the bladder, by the absence of pain and of those severe constitutional symptoms which characterise the latter disease. If it has been of long standing, it may be distinguished from chronic inflammation of the bladder, by the general health suffering but little; whereas in chronic inflammation, the constitutional powers sooner or later give way. In the following case the complaint was of very long duration, and the health but little affected.

A gentleman, sixty-five years of age, of good constitution, and regular habits, consulted me on account of a very frequent desire to pass urine, unaccompanied by stricture, disease of the prostate, or any other affection that I could detect. Thirty years previously he had consulted Mr. Jesse Foot for the same complaint; and the lotura vesicæ was then tried without affording relief. This symptom has continued ever since, being aggravated in cold weather, and on any excess in living or derangement in the health. In other respects he is quite well.

Those cases in which the cause of irritability, supposed to be confined to the bladder, is, in truth, to be referred to the kidneys, though often attended with great obscurity, may generally be elucidated by attention to the symptoms, and accurate by repeated analyses of the urine. Dr. George Johnson, in his recent work on diseases of the kidney, has observed that irritability of the bladder accompanies almost every

form of organic renal disease; but we must not conclude from this that the former complaint invariably indicates the latter.

Morgagni* relates a case in which the bladder was thus the seat of sympathetic pain; the disease being in the kidneys. The patient, he says, complained of very little pain in the region of the kidney; while he was tormented with pain in the bladder, so excruciating that five or six physicians who attended him entertained no doubt of the seat of the disease being in that organ. On dissection, however, no morbid appearance was discovered in the bladder; and there were large and ramifying calculi in the kidney.

In certain renal affections in particular habits, says Dr. Prout, even where the urine is not very unnatural, the pain is confined chiefly to the neck of the bladder; but when the urine indicates mischief, and more especially when it is alkaline, we may be certain that the kidney is functionally, and if the patient be of scrofulous habit, and the case of long standing, very probably organically affected.

In idiopathic irritability of the bladder, which has not been of long continuance, the treatment is usually plain; the state of the general health and the condition of the urine being our guide. In gouty and rheumatic subjects, in whom the urine is generally acid and scanty, and red sand often passed, the alkalies should be administered; and a good form for their exhibition is a combination of potash, soda, and nitre. The carbonate of potash is to be preferred to the

* On the Seats and Causes of Disease. Letter XLII.

carbonate of soda, because, under certain circumstances, soda enters into combination with the uric acid, forming an insoluble salt, as deleterious as that acid itself: whereas the urate of potash is perfectly soluble, and if this combination should take place, it passes off dissolved in the urine. In addition to the alkalies, the acetous extract of colchicum, in doses of one or two grains, should be given at bed-time; and if the digestive powers be weak, as is often the case, some tonic, as infusion of cascarilla, columba, or hop, a short time before meals, will be found serviceable. Great relief will sometimes be obtained from cupping on the perinæum, the warm bath, the use of the liquor potassæ and tincture of hyoscyamus, and occasional doses of blue pill and saline aperients. When we can trace the irritable state of the bladder to mischief in the kidney, setons and issues in the lumbar region in addition to other means must be employed.

In these, and indeed in all cases, the strictest attention should be paid to diet. Vegetables and fruit should be avoided, as well as wine, spirits, and all fermented liquors.

In some constitutions, notwithstanding the acid state of the urine, and the deposition of a large quantity of the urate of ammonia, the alkalies disagree, producing restlessness, giddiness, and uneasiness about the region of the stomach. I recently saw a gentleman who had great irritability of the bladder, and whose urine, which was very acid, deposited great quantities of the urate of ammonia, but who could not bear even small doses of alkaline remedies.

If the patient be of a nervous temperament, and the

urine alkaline, a different plan of treatment will be necessary. The dilute mineral acids, combined with the decoction of pareira brava, should be administered, and everything having a tendency to lower the system, as attention to business, study, or anxiety, studiously avoided.

In other cases, where the urine is neutral, the extract of the uva ursi, in five grain doses, combined with that of the hop or hyoscyamus, may be taken in single or double doses, three times a day. Opiate suppositories or injections per anum, with some drops of the liquor opii sedat. may be administered, according to the severity of the symptoms. I usually direct seven or eight grains of the soap and opium pill to be administered in this way at bed-time, or the liquor opii sedativus in an injection of starch or gruel.

The decoction of uva ursi, and the infusion of wild carrot-seeds, will occasionally give great relief. In my experience, however, no medicine has been so generally successful in irritability of the bladder, as the infusion of diosma. I could cite several cases, where it has succeeded after other medicines had failed. A gentleman, æt. twenty-one, applied to me on account of an affection of the bladder. He said that, for the previous eleven or twelve years, he had experienced great difficulty in retaining his water for any length of time, being obliged to void it once or oftener in the hour. The moment the desire to micturate came on, the water, unless the desire was immediately complied with, passed away involuntarily. This irritability of the bladder was always very much aggravated by the use of malt liquors, wine, or spirits, and by ex-

posure to cold. Latterly it had considerably increased. He was very susceptible of cold, complained of pains down the inside of the thighs, but had no pain in the region of the loins on pressure, nor any over the bladder, and his general health had not suffered. The urine was neutral and light-coloured. After trying the various preparations of steel, the decoction of pareira brava and henbane in different forms, without success, I ordered the infusion of diosma, with great benefit.

From time immemorial, the buchu leaves have been held in great esteem by the natives of the Cape of Good Hope, as a remedy for a number of diseases, particularly irritative or chronic inflammatory affections of the urethra, bladder, prostate gland, and rectum, and also for rheumatism, indigestion, and gravel. These leaves have been very successfully prescribed in the same complaints, both in Holland and in this country. There are several species of this shrub, but that termed "Diosma crenata," is most esteemed for its medicinal virtues. It affords, on distillation, an essential oil, resembling a mixture of oil and rue, juniper, and camphor; the extractive matter being slightly bitter and mucilaginous. The natives of the Cape, and the Dutch, who have learned from them the use of the plant, are partial to the spirit of buchu, made by distilling the leaves in the dregs of wine, and called buchu brandy. They regard it as a sovereign remedy for all chronic and even for acute diseases, of the stomach and bladder, especially spasmodic pains in the stomach and intestines.

When a scaly eruption is present and the urine

acid, the bicarbonate of potash, tincture of henbane, and the fluid extract of sarsaparilla added to the infusion of diosma make a very useful formula; but the alkali must be omitted if the urine is not acid.

Mr. Jesse Foot, was a great advocate for injecting the bladder in cases of irritation of that organ; but since his time the plan has never been extensively tried in this country. Mr. Wadd, indeed, mentions two cases in which great relief was experienced from the lotura vesicæ, and expresses his surprise that it is not more resorted to by practitioners. The bladder may be injected with simple tepid water, or with some bland mucilaginous decoction, as that of quince seeds or linseed; and the injection may be repeated once or twice a day, the quantity thrown up, and the time of retaining it, being gradually increased. I have tried the injection of the bladder in cases of simple irritability, but am disappointed in the results. It is certainly a valuable remedy in an affection of the bladder hereafter to be noticed; but I do not consider it of use in the complaint now under consideration.

Irritation of the bladder and urethra dependent on gout and rheumatism, yields in general to the administration of colchicum, combined, if necessary, with a narcotic at bed-time. Dover's powder is usually selected, but I prefer the preparations of morphium. The iodide of potassium deserves a trial from its well-known curative influence in rheumatic affections. Guaiacum also has been strongly recommended, but I have no great faith in its efficacy.

In the irritability of the bladder met with in young females at the time when menstruation should take

place, or when some irregularity in that function has occurred, the preparations of iron are of great service. The ammoniated or the muriated tincture of iron, given in some light bitter infusion, is serviceable; and if the bowels be costive during the use of the remedy, the compound decoction of aloes should be daily administered. The bowels should be kept well open, for the symptoms of the disease are invariably aggravated when the bowels become costive. If there be much hysteria, the tincture of valerian, combined with the vinum aloes, may be also tried with benefit. The cold shower-bath will likewise be found very serviceable in such cases.

Where there is much general debility, and the disease appears to be connected with the scrofulous diathesis, the muriated tincture of iron will be found useful.

When other remedies have failed, I have known the tincture of cantharides succeed. I was consulted by a woman who suffered from incontinence of urine at night, through irritability of the bladder. She was healthy looking, temperate in her habits, and twenty-two years of age. She had been recently married, and was much distressed by the complaint under which she laboured. There were no pains in the loins, nor any symptoms of disturbed secretion in the kidneys. I ordered her to take five drops of the tincture of cantharides three times a day in a little water, and in a few weeks the complaint entirely ceased.

In children, incontinence of urine usually depends on an excitable state of the bladder, as I have before stated, or an altered condition of urine. In either instance, the bladder cannot contain more than a small

quantity of urine, before the call to void it is felt, and this is so sudden and irresistible, that it must be obeyed, or the contents are at once expelled. In some cases it occurs during sleep, and the urine often passes off voluntarily under the influence of a dream.

It has been observed that this state hardly amounts to disease, but depends upon an unusual and temporary susceptibility of the vesical nerves to the stimulus of distension; so that, when this has once reached a certain pitch, the action of the antagonising muscles is of no avail, and the law established between the sensation resulting from that distension, and the generation of motor power, enforces instant obedience. It is commonly thought that these circumstances are to be overcome by punishment; yet unless the principle upon which punishment operates be strictly kept in view, the unfortunate boy may be, as indeed he often is, subjected to unavailing cruelty. Punishment can only operate by awakening attention to the first approaches of the sensation; so that the child may anticipate, by an act of will, that degree of distension which enforces the sequence, and which, when it has arisen, no effort of the will, even under the dread of punishment, is adequate to resist.

It is a good plan to prevent the sleep being too long and to awaken the child at stated periods that he evacuate the bladder. The affection, however, is often very troublesome, and requires great determination on the part of the little patient, as well as patience and firmness in those about him for its cure.

The result of modern investigation shows that cases of pure idiopathic irritable bladder are not so common

as has been heretofore supposed, and that the frequent desire to micturate, indicates an unnatural state of the urine, or the existence of some organic disease, exercising by sympathy an influence upon the bladder. Their relation to stomach complaints has been abundantly shown by Dr. Prout.

Although, therefore, some forms of irritable bladder may appear so trifling as scarcely to deserve remark in this work, it should be remembered that in their investigation and diagnosis in practice, there is required a general acquaintance with the different forms of renal and other urinary diseases, and the power of ascertaining by chemical analysis with considerable accuracy the nature and relative proportions of the ingredients in the urine.

CHAPTER III.

SPASM OF THE BLADDER.

The bladder, like any other muscular organ, is subject to spasm, an affection arising from many causes, and differing from irritability, inasmuch as the attacks occur at intervals between which the patient enjoys perfect ease.

A fit of stone, as it is familiarly called, is an example of a violent paroxysm of spasm of the bladder; and in various affections of the uterus and rectum the organ is liable to attacks of a similar nature. The patient, who is suddenly attacked, experiences severe pain extending from the region of the bladder, along the urethra to the extremity of the penis. The urine may be expelled involuntarily, but more commonly there is retention with some amount of suppression from the orifice of the ureters being closed by the spasm. There is constant desire to void urine without the ability to do so, and the agony felt during the continuance of these attacks is excessive; while the pressure of the hard and contracted bladder on the rectum, excites a feeling of desire to evacuate the contents of the bowel.

This affection is almost invariably a concomitant of stone in the bladder; it is frequently produced by malignant tumours; and it very often accompanies gonorrhœa, especially when injections have been employed either too strong in composition or too early in the treatment: in the latter instance the disease affects the sphincter vesicæ more especially, and is usually attended with more or less inflammation.

Cases are related in which the patient has expired with all the symptoms of suppression of urine, and upon examination after death, it has been found that the ureters, spasmodically closed at their vesical extremity, have been dilated by the accumulated urine; while the pelves of the kidneys were similarly enlarged, and the substance of the kidneys diseased. Indeed after an attack of spasm from which the patient has apparently recovered, we may subsequently have to treat a new train of symptoms indicating the injury which the tubular and secreting substance of the kidney has received. Spasm of the bladder, says Dr. Prout, may arise from the presence of acid urine, or from an abscess in the kidney, from ulceration or other organic disease of the bladder, prostate, &c., from retention of urine, from gout, from excessive venery, the use of irritating diuretics, as cantharides; from various diseases of the intestinal canal, as worms, and especially ascarides, from hysteria, &c. These are causes of irritation, and it can be readily understood how any great irritation, especially about the neck of the bladder, may excite spasmodic contraction of that organ.

Spasm may be confounded with acute inflammation

of the bladder. In inflammation, however, the pain is constant, commencing with more of uneasiness than of positive pain, and becoming more intense by degrees; while in spasm, the seizure is as severe as it is sudden. In the former, the pain has the usual character of inflammation—it is lancinating and throbbing; whereas in the latter it is constrictive, resembling, in fact, labour-pains. In both there usually is retention of urine.

Spasm of the bladder, when of long standing, often gives rise to hypertrophy of the muscular tissue, and the paroxysms then may bear considerable resemblance to those of stone; but its frequent recurrence sometimes injures the tone of the bladder so much as eventually to induce an opposite state of the muscular fibres: in other words, the disease terminates in paralysis of the bladder.

The treatment of the disease must necessarily vary with the cause whence it originates. If spasm be conjoined with inflammation, we are called upon to adopt a strict antiphlogistic mode of cure: leeches are to be applied over the pubes, or to the perinæum; if the symptoms be violent, and go on increasing in intensity, venesection must be had recourse to, and repeated if demanded by the urgency of the case. These means are to be followed by the warm bath, local fomentations, and opiates, which are to be administered both by the mouth and in the form of enemata.

If there be reason to believe that the affection originates in a gouty diathesis, or owes its presence to a suppression of a paroxysm of this disease, while we endeavour to allay the symptoms affecting the bladder,

we should attempt at the same time to induce the gouty paroxysm; for this purpose we should apply sinapisms to the feet, or even blisters to the calves of the legs. The operation, indeed, of the latter assists, as Soemmering has already observed, the treatment in a peculiar manner; because they often prove most beneficial in the removal of a morbid state of the bladder, which otherwise they are apt to induce. Among the palliatives of the symptoms affecting the bladder, I have found none more efficacious than a combination of colchicum, opium, and camphor, or hyoscyamus. As soon as we have removed the arthritic strangury, we are to direct our attention to the systematic treatment of the disease, to avert its recurrence.

In cases where the cause is attributable to the improper use of injections in urethritis, the treatment does not differ in principle from that laid down for spasm combined with inflammation. General bleeding will rarely be required; but as the usual effect of strong injections is to stop the discharge, we are to use every soothing means to procure its return.

If the cause of the spasm proceed from the kidney, our plan of treatment, after removing the pressing symptoms, must be founded on the removal of the original source of the affection; since, as far as the spasm is concerned, we can never expect to prevent its recurrence, unless we cure the disease from which it proceeds.

The same observations apply when spasm of the bladder arises from the presence of a calculus. Our treatment can only be palliative and of a temporising nature; for nothing but the extraction of the stone can

be relied upon for a permanent cure. As an immediate means of relief, no medicine is preferable to opiates, which may be exhibited by the mouth, or in form of enema or suppository.

In cases of spasm of the bladder proceeding from sympathy with some contiguous organ which derives its nerves from the same source, the tinctura ferri sesquichloridi often proves of great service. The sphincter vesicæ is commonly the seat of the spasm, and with it we consequently have retention of urine. The operation, therefore, of the remedy appears to be purely antispasmodic, and its influence frequently is almost immediate. The usual mode of administration is to give fifteen to thirty minims every quarter of an hour until the spasm yields.

Where there is reason for suspecting that the acrid quality of the urine is a main exciting cause of the spasm, the indication of diluting the urine by drinking freely of some diuretic beverage is obvious; and when acidity is the predominant character, this must be abated by exhibiting alkalies with the diluent: or if strongly alkalescent, this condition must be altered by the administration of some mineral acid.

A poultice containing powdered camphor is frequently very serviceable when applied to the perinæum. Some recommend a liniment, composed of camphor and opium, to be rubbed on the same part. Emollient clysters containing some of the watery extract of opium often afford instant relief. In all cases where we have any reason to suspect the existence of irritation about the rectum or lower bowel and neighbouring parts, laxative remedies should be employed.

A tobacco enema has been recommended by some in cases of strangury affecting old people; but it is at all times a dangerous remedy, and, in my opinion, ought never to be employed. Others have given the same medicine by the mouth. It is one of the most powerful of the antispasmodics, it must be granted; but its efficacy is uncertain, and its hazardous properties unequivocal.

In all obstinate cases we are to watch lest inflammation supervene; should it occur, we must immediately have recourse to bleeding both general and topical, and rigorously adopt all the other means known to abate and remove inflammatory action.

The diet of patients liable to attacks of spasm of the bladder must be carefully regulated, and every excess, whether in food or drink, scrupulously avoided. The patient should protect himself against sudden changes of the atmosphere, and wear flannel clothing next the skin; any violent exercise, or riding on horseback, must also be avoided, as likely to increase the nervous irritability about the neck of the bladder, with which spasm is so frequently connected as an effect.

CHAPTER IV.

PARALYSIS OF THE BLADDER.

The muscular coat of the bladder may become paralysed from any of those causes which induce loss of muscular force in other parts of the body. There may be either simple diminution or complete loss of expulsive power; and the paralysis may be temporary or permanent. It is also important to remark that the loss of power may be idiopathic or sympathetic; depending in the first case on influences confined to the bladder itself; and in the second, resulting from affections in other parts of the body, or from the general health of the individual. Thus, a patient suffering from any disease—phthisis, for instance—which produces general debility and wasting, is frequently subject, at irregular intervals, to more or less inconvenience and difficulty in expelling urine. This arises not merely from loss of power in the abdominal muscles, whose contraction aids the first expulsive efforts of the detrusor urinæ, but from weakness in the bladder itself, the stream flowing slowly and the organ often being imperfectly emptied.

A person, being in the presence of females or in some inconvenient situation, neglects to empty the bladder,

and upon attempting afterwards to relieve himself, he finds that he has lost the power. The urine is then either drawn off by the catheter, or in the course of some hours it flows by the patient's own efforts; after which, the organ resumes its usual functions. This is an example of idiopathic and partial paralysis, produced by over-distension of the muscular fibres of the organ.

Unlike the rectum, the bladder retains its contents when paralysed; and much has been written both in this country and abroad to explain why such opposite results should ensue from the same cause in two organs almost similarly constructed, in juxta-position, and supplied by the same system of nerves. The explanation of the phenomenon lies in some peculiarity in the neck of the bladder not possessed by the rectum; the sphincter vesicæ, if indeed there be any such muscle, does not lose its power of contraction, to the same extent at least, as the sphincter ani. There are undoubtedly circular muscular fibres around the neck of the bladder, under the longitudinal fibres; but they are pale and mixed with elastic tissue, by which their action is essentially modified. The same loss of power which allows the escape of fecal matter through the paralysed sphincter ani, does not affect to a similar degree the sphincter vesicæ, whose elasticity inherent in the tissue itself, and not dependent upon nervous influence, retains closed the vesical orifice when the rest of the organ is paralysed. The neck of the bladder and the prostate gland are fixed *in situ* by the pelvic fascia, and by the ligaments of the bladder; in distension of the organ, therefore, this part does not rise from the pelvis. Indeed the trigonum vesicæ imme-

diately behind the prostate, sinks lower, and against the anterior surface of the rectum. In other parts the walls of the bladder yield and mount towards, sometimes even above the umbilicus, and if the distending cause be slowly produced, press the other viscera against the diaphragm. When the bladder is full, it flows over; in other words, the urine dribbles through the urethra, the resistance to its escape at the neck being overcome when the walls of the organ are dilated to their utmost extent. Thus it is that incontinence of urine is often a symptom of retention; but the latter may arise from many other causes besides paralysis; and hence the surgeon cannot be too careful in his examination of a case, before he undertakes its treatment. In illustration of this important point, Mr. Lawrence states the following case:—"It happened to me, a good while ago, to be sent for, to see a gentleman labouring under an affection of the bladder; and the medical attendant, who had lately seen him, mentioned that the case was one of great irritability of the bladder, which would hold no water at all—the urine passing off as fast as it came into it. He said he had been doing all he could to get the bladder's natural power of retention restored; he had directed the patient to take diluent liquids; in short, he had done all he could to prevent it; but still the water ran off. It appeared to be a singular case. I put my hand under the clothes upon the abdomen; and I felt the fundus of the bladder forced up a good way above the umbilicus. I said that I had brought a catheter with me, and that I might as well introduce it, to see if there was anything in the bladder. I introduced it; and about five pints of urine immediately

flowed off. The fact was, the bladder had been, in this way, allowed to distend for about five days before I saw the patient; and the consequence was, that he never afterwards recovered the natural power of emptying that viscus; but he acquired, after a certain time, the art of introducing the catheter, which he still employs: he can introduce it, and let the water off whenever he finds a desire to do so; but since that time he never has been able to empty the bladder by the natural powers."

I have met with cases in which the sudden abstraction of a large quantity of urine from a bladder which had been long paralysed, was followed by severe constitutional symptoms,—by rapid collapse, and even by death. One case in particular occurs to me. I was consulted by a gentleman in consequence of a constant desire to micturate, a very small quantity of urine only being passed at a time. After he had made water, and thought he had completely emptied the bladder, I introduced a catheter and drew off a pint and a half of urine extremely fetid, turbid, and mixed with thick muco-purulent matter. From this time the catheter was passed three times a day, but in a fortnight afterwards he suddenly became comatose, and in three days he died.

If, by the use of the catheter, the bladder should happily recover its natural power, the patient must be strongly impressed with the importance of never again allowing the urine to accumulate in such quantity, but of immediately passing it as often as he feels the smallest inclination; or, if unable to expel the urine, of making timely use of the catheter. The patient ought

also to be informed of the necessity, on every occasion, of voiding the urine even to the last drop.

The circumstances under which the disease occurs should be carefully studied.

Although it is often met with in old persons, as I shall presently show, it not unfrequently occurs in others who are under thirty-five or forty years of age, and whose constitutions have been impaired by venereal excesses, long courses of mercury, anxiety, fatigue, and excessive attention to business. Before the attack, the patient complains of pain in the head, or some part of the back, weakness in the loins, and inability to walk firmly, flatulence, or a sense of fulness in the epigastric region, and he feels and looks as if threatened with some impending mischief. If these symptoms be not relieved, paralysis of the lower extremities often follows; and the bladder partakes of the affection.

I have known, however, paralysis of the bladder to occur where the previous habits were regular, and the state of health was in other respects good. There is a large class of cases of paralysis, in which the symptoms closely resemble those of irritation, and are often mistaken for it. A patient complains that during the day he is troubled with constant desire to make water; every half-hour, and, indeed, sometimes more frequently, he is constrained to relieve the bladder; his business and his pleasures are both interfered with; and he is afraid to trust himself for any length of time from home. During the night his urine passes involuntarily, and his rest is broken from the dread of finding his bed wet. The offensive odour proceeding from a person subject to this complaint,

renders him unfit for society, as even artificial means cannot completely remedy the evil.

In such a case the bladder has become partially paralysed. It permits of considerable dilatation, and contains, under all circumstances, several ounces of urine, and it is only when the accumulation passes beyond the detrusor's point of sufferance, that a feeble contraction produces partial relief. The treatment is clear. The patient should be told to make water in the presence of the surgeon, and immediately afterwards a catheter should be introduced, when, to the patient's surprise, several ounces of urine will come away. This condition is often connected with stricture or enlargement of the prostate, and is generally described in treating of these affections; but I have very frequently met with it even in persons of middle age, in whom there was no perceptible change of structure in the parts surrounding the neck of the bladder or in the urethra itself.

The patients are not aware of the fact that the bladder is not completely evacuated when they urinate. Indeed, the frequent calls are likely to lead them to an opposite conclusion. Hence the quantity of urine retained after each call goes on gradually increasing; the bladder slowly loses its expulsive powers, and the nature of the disease is not detected until some remarkable change in the quality of the urine, or, perhaps, sudden suppression, lead to a proper surgical examination.

I was recently consulted by a patient for supposed irritation of the bladder, the desire to make water coming on every half-hour. I desired him to make water before

me, and to empty his bladder; I then passed into the bladder, without the slightest difficulty, a full-sized catheter, and, to the man's astonishment, drew off more than two pints of water. The bladder has not yet recovered its power of contracting, and the patient still requires the frequent use of the catheter; but he can pass it for himself, and is thus relieved of a quantity of turbid and offensive urine, which, in course of time, would have produced changes in the coats of the bladder, and increased the evil. So long as a quantity of urine remains in the bladder, there is no chance of the organ regaining its contractile power; a mistake of diagnosis, therefore, may be attended with very serious consequences.

It was noticed by Hunter, that when the bladder has been over-distended, the mucous membrane becomes mottled with spots of extravasated blood, and the urine itself is often dark-coloured from the same cause. When there is no organic change in the prostate gland, no calculus, nor any disease of the spinal chord, the kidneys being healthy, the urine does not manifest at first any deviation from the condition of health; but as the urine stagnates and accumulates in the bladder, it excites irritation of the mucous membrane, and becomes charged with various abnormal elements.

Paralysis of the bladder may be a consequence of injuries to the head, or of apoplexy; but it falls most frequently under the notice of the surgeon as the effect of injuries or diseases of the spine; and these cases are attended with important changes in the whole urinary system, as well as in the condition of the urine itself. The changes here referred to do not appear to be

connected with the particular locality of the injury; they occur equally whether the accident be in the lumbar, dorsal, or cervical regions.

In some cases, the urine first secreted, though free from mucus, and of an acid quality, has an offensive and disgusting odour. In other cases, the urine is highly acid, has an opaque yellow appearance, and deposits a yellow amorphous sediment. After slight accidents, such as a strain in the loins, this state of the secretion usually disappears under proper treatment in the course of a few days. But the most common change produced in the urine by injury of the spinal chord, is the following: when voided, it is turbid, and of ammoniacal odour; when allowed to remain at rest and to cool it deposits much adhesive mucus; and, when tested with reddened litmus or turmeric paper, it is found to be highly alkaline; after some time, a quantity of phosphate of lime may be detected in the mucus, and it is tinged with blood; at a later period, a considerable quantity of sanguineous coagulum is blended with the mucus and urine.

The urine received into a hollow organ, whose vital power has been lowered by injury inflicted upon the spinal chord, undergoes partial decomposition. The urea becomes converted into carbonate of ammonia, and the urine thus rendered ammoniacal, excites inflammation of the mucous membrane of the bladder, which pours forth in consequence a large quantity of viscid ropy mucus. The phosphatic salt most frequently found mixed with this secretion is the neutral triple phosphate of magnesia and ammonia, the prismatic crystals of which, presenting different degrees of transparency, form

under the microscope very beautiful and easily recognised objects.

If the patient live long enough, the inflammation thus excited by the decomposed urine in the paralysed bladder spreads through the whole thickness of the vesical walls, which are rendered thicker than usual, lose all power of contraction, and sometimes form connexions with the walls of the abdomen and adjacent viscera. The catheter under these circumstances, fails in completely drawing off the contents of the bladder; a quantity of highly alkaline and fetid urine remains to add to the local disturbance, and to impregnate any fresh secretion as it enters the organ from the ureters.

According to the views now stated, it would appear that the changes which take place in the urine during paralysis of the bladder from paraplegia, depend on the circumstance of the bladder having lost its nervous influence, in consequence of which the urine becomes decomposed. Mr. Curling,* however, does not consider this explanation satisfactory. He thinks that the decomposition of the urine depends partly on the injury which the bladder sustains from over-distension and from the irritation caused by the use of the catheter, or by the presence of unhealthy urine. Mr. Curling also supposes that the alkaline state of the urine is an effect of the condition of the bladder. On the other hand, Dr. Burne has shown that the urine may come acid from the kidneys and be excreted ammoniacal from the bladder.

Dr. John Snow† has observed, that healthy urine

* Medical Gazette, vol. xiii, p. 76.

† Ibid., Nov. 26th, 1846.

will keep fresh out of the body at blood-heat, just as long as it would remain fresh in the bladder; and with respect to the change in the mucus, there is every reason to believe that in these cases it is the consequence, and not the cause of the alkalescence of the urine.

In paralysis of the bladder, the principal uneasiness appears to arise from the pressure of the urine against the neck of this viscus, and the pain is referred to this part and to the glans penis: as the distension increases, these symptoms go off, and the patient does not even experience an inclination to void urine. This arises from the bladder having lost its sensibility, so that pressure is no longer felt, although the bladder is now pressing backwards upon the rectum, and forwards against the abdominal muscles. The local symptoms have now in a great measure subsided; but others come on, showing the great disturbance of the constitution; there is a quick pulse, great thirst, general irritation, anxiety of mind, the tongue is covered with a brown fur, and the patient becomes delirious, with intervals of stupor. Under these symptoms the patient dies, and is not uncommonly believed to have been carried off by typhus fever, totally unconnected with the disease of the neck of the bladder.

Lallemand remarks,* that we must ascribe to diminution of sensibility the distension of the bladder and the inflammation of its mucous membrane, observed in disease of the brain and its membranes, when such disease is accompanied with stupor, drowsiness, &c.

* Letter II, p. 236.

In that case, the patient makes no effort to expel the urine from the bladder, because he does not feel the impression made by it: hence it accumulates and distends the parietes of that organ as long as they admit of dilatation, until their resistance being greater than that of the neck of the bladder, the surplus urine dribbles away as slowly as it is conveyed by the ureters, that is drop by drop. In cases of this and the preceding kind paralysis of the rectum sometimes accompanies the loss of power observed in the bladder.

This complaint often attacks elderly persons, particularly those who are gouty and rheumatic. It is the result of general diminution of nervous and muscular power; the bladder being less sensible to the stimulus of the urine, and being incapable of obeying the will with the same facility as before.

Paralysis of the bladder, Soemmering observes, is peculiarly a disease of old age—the excitability of the organic formation, particularly that of the muscular fibres, gradually decreases; the susceptibility of the nerves becomes limited, and the cellular membrane loses its tone. Hence, he says, an attack of paralysis is often long announced by weakness in the loins, tottering in the step, and bending of the knees in walking, and from this it may almost always be inferred, that a considerable alteration in the functions of the spinal marrow, and of the nerves proceeding from it and from the sacrum to the bladder, has taken place.

The bladder is rendered incapable of obeying the will with the same facility as before: no longer so susceptible of the customary excitement, it yields to the urine, and becomes distended, sometimes to an enormous

size. Haller saw the bladder of a great drinker, which was able to contain twenty pounds weight of water. Frank found the bladder so distended as to give the appearance of dropsy; twelve pounds of urine passed at one time through the catheter, although the whole was not removed.

But in old people difficulty in voiding the urine depends most commonly upon some change of structure in the neck of the bladder or in the prostate; or the paralysis may be secondary, and dependent upon over-distension of the organ from the difficulty experienced by the patient in overcoming some mechanical obstruction. Indeed simple paralysis of the bladder is a rarer disease of old age than has hitherto been supposed. Morbid anatomy gives us no proof of atrophy or wasting of the detrusor urinæ any more than of the muscular fibres of the stomach or of the heart, while there are abundant specimens to show how common are enlargements of the prostate, tumours or other similar affections which, by impeding the flow of urine, might make the patient believe that the organ was paralysed. Mercier remarks,* "that almost all who have written on the diseases of the urinary passages say that the contractile power of the bladder can be weakened, or indeed destroyed, by old age, venereal excesses, masturbation, the habit of passing water at too long intervals, etc." He mentions numerous facts to show how frequently some mechanical obstruction is the real cause of the difficulty, and adds, with much truth: "I do not deny that old age weakens the muscular

* Recherches sur les Valvules du Col de la Vessie.

fibres of this organ; but it weakens at the same time those that close its orifice, and are concerned in maintaining the equilibrium." In the examination of the bladder of an old person who has long been subject to difficulty in voiding the urine, we may, it is true, find the walls of the organ thin, but I have hitherto failed, after most careful examination, to detect in the muscular structure that degeneration by which the fibres become changed in appearance, paler than natural, or altogether disappear. If paralysis of the bladder be so common a disease of old age, as has been stated, why is it that atrophy of the walls of the organ is so rare? The infrequency of its occurrence is noticed by Rokitansky, than whom no one has had a wider field of experience. "Atrophy of the vesical parietes," he says, "occurs rarely. The mucous membrane may be reduced to a very delicate shining membrane, resembling the arachnoid, and the muscular coat disappears with the exception of a few almost imperceptible pale traces; the contractile power of the bladder ceases; its parietes are in a state of permanent relaxation, soft, thin, transparent, pale, anæmic, and friable." Rokitansky only twice observed atrophy of the vesical parietes of this description as a substantive disease.

I am not prepared to acquiesce with Soemmering when he says, after describing the weakness of the loins, the tottering steps and bending knees of the old, that these symptoms announce an approaching attack of paralysis of the bladder; and that from them it may always be inferred that a considerable alteration in the functions of the spinal marrow, and of the nerves

proceeding from it, and from the sacrum to the bladder, has taken place. The tottering step and the yielding knees are associated with those changes in the muscular, as well as in the nervous system, to which in old age the frame is subject; but the difficulty in expelling the urine which comes on at a later period is not always due to paralysis,—it is often the result of some mechanical impediment offered by the structures about the neck of the bladder which have become enlarged and otherwise altered. Hence it is more common in these cases to find the muscular coat of the bladder positively hypertrophied, the organ having been called upon to overcome an unnatural degree of resistance. M. Civiale, in several of his recent works, has directed attention to a species of partial paralysis, accompanied by hypertrophy of the musculiar fibres of the bladder. In cases of this kind, the paralysis often gives rise to such distension of the organ, that it rises above the pubes, and forms a tumour in the abdomen. The swelling is more firm and resisting than when it accompanies retention with atrophy of the vesical parietes; and it is also more painful, for the disease is almost always accompanied by chronic inflammation of the organ, and particularly of its muscular fibres.

Authors have described paralysis of the bladder as a result of venereal excesses and of masturbation. The general debility which may result from such habits will affect this organ as well as other parts of the body; but, as far as my own professional experience goes, I should say that the usual result would be irritability of the bladder, dependent upon a morbidly sensitive con-

dition of the mucous membrane of the urethra; for patients commonly complain of a tingling sensation at the glans penis, and of a constant desire to pass water, which is voided in very small quantities. Indeed the smarting sensation at the end of the urethra becomes intolerable when a small quantity of urine is collected in the bladder.

The incontinence of urine observed in children, and also in others of a weakly and scrofulous constitution, cannot be explained upon the supposition of paralysis of the bladder, further than that there is a want of equilibrium between the retaining and the expulsive forces. In many instances there is some morbid condition of the urine which excites undue contractions of the bladder: and such cases would, therefore, come under the head of irritable bladder. The following is an example:—A child, six or seven years old, with a large head, pale countenance, bad teeth, prominent sternum, large abdomen, and emaciated extremities, had, from its earliest infancy, suffered from incontinence of urine. All kinds of remedies had been tried without success. In this case, as in many others, there was great irritability of the bladder during the day, and, unless the desire to pass urine was attended to, it flowed off involuntarily. The urine was very acid.

Children, while labouring under hooping-cough, and at the time of dentition, are liable to retention of urine. Joseph Wm. Brett, æt. 2½ years, whilst labouring under hooping-cough, was seized with inability to pass urine. Two days before, the mother had, on three occasions, observed some blood in the child's urine, and some red sand deposited in the urinal. A small catheter was

introduced, and a pint of urine drawn off. After twenty-four hours this operation was again repeated, and the functions of the bladder gradually returned.

Incontinence or retention of urine may arise from paralysis of the bladder, but these states may also depend on a variety of other circumstances, some of which may be here noticed. Thus in some persons, particularly in stout females, the urine will flow involuntarily on lifting a weight, or coughing, or any violent exercise. In such cases there is no pain, no blood in the urine, no desire to make water often, but merely an involuntary flow on exertion—the action of the diaphragm and abdominal muscles overcoming that of the sphincter of the bladder. In females, incontinence often occurs after distension of the urethra for the extraction of calculi or foreign bodies, and occasionally after difficult labours. Dr. Cory* relates a case of the latter, which speedily yielded to the one-sixteenth part of a grain of strychnia given three times a day. In these cases it is probable that the sphincter vesicæ had been injured, and they might properly be described as injuries to the neck of the bladder, the mechanism of which is no longer able to close the orifice. In the female urethra, division of the elastic structures forming its walls, and of the loop of muscular fibres immediately round the neck of the bladder in the course of a surgical operation, is often followed by incontinence of urine; but these again are not cases of paralysis.

I will here mention a paralysed condition of the

* Medical Gazette, March 16th, 1839.

neck of the bladder in women who have had very large families—ten or twelve children for example.

In these cases, more especially if the child is large, or the pelvis small, and the labour has been severe, the bladder is apt to get so infirm about the neck, that it loses much of its contractile power, and, perhaps, from the moment of delivery, the woman is incapable of retaining the water: or if at any time she chance to cough, laugh, rise suddenly, or in any other manner contract smartly the abdominal muscles, the water comes gushing away. For years this disease may continue with greater or less severity, but it frequently cures itself in good measure, and the first few weeks after delivery, say at the end of the fortnight, the patient is better; at the end of the month the retentive powers are still more increased; and in the course of a few more weeks she becomes able to retain the urine very well, though still liable to gushes when sudden efforts are made. Hence, where inconvenience is the result of an enfeebled cervix vesicæ, time must be looked upon as one of the principal remedial means; in some cases, advantage may be obtained from plunging the hips into cold water two or three times daily. The improvement of the general health is by no means to be neglected, for the more we improve the general health, the more we increase those healing powers of the parts on which all cures are more immediately dependent.*

In the case of a lady on whom I operated for hæmorhoids, the bladder became paralysed, and she required the use of the catheter for some days before it recovered

* See Dr. James Blundell's Lectures. Lancet, 1828, p. 73.

its usual power. In fact, paralysis of the bladder after an operation for piles is not an unfrequent occurrence. Paralysis of the bladder has occasionally occurred from the use of opiate suppositories, or injections; so that it has been necessary to draw the water off, and much alarm has been occasioned by the accident; but in many other cases the bladder cannot be said to be in a state of paralysis, for in most of them the cause acts as a mechanical impediment. The rectum may be distended by flatus, blood, morbid growths, or a foreign body; and, in these states, the neck of the bladder and the urethra may be compressed.

I have seen a case of diseased hip-joint, in which matter made its escape from the affected joint into the pelvis, so as to press on the neck of the bladder, and cause retention of urine. On examination, after death, I discovered that the matter had escaped through the acetabulum to the posterior part of the bladder, and had made a lodgment close to its neck.

There are two periods in pregnancy* when women are especially exposed to retention of urine, about the fourth month, and at the time of confinement. It must be recollected, that, in the first month, the womb continues as before conception, in the depth of the pelvis, and does not ascend above the cavity until the fifth month, and sometimes even later. Up to that period its size and weight having progressively increased, it descends towards the vagina, and, in the manner of a wedge, may press posteriorly the rectum, and anteriorly the neck of the bladder, and the urethra against

* Traité des Maladies des Voies Urinaires, par Desault, p. 160.

the symphysis of the pubes, to such a degree, as to obstruct the opening of that canal.

The displacements of viscera which most frequently give rise to retention of urine, are retroversion of the womb, and prolapsus of that organ, of the vagina and rectum. If we examine the connection of the bladder both with the womb and vagina in the female, and with the rectum in the male, it is evident that these parts cannot be displaced without drawing with them the bladder; and that, in such displacement, whatever may be its contractile force, it cannot entirely expel the contained urine.

In prolapsus and retroversion of the womb, and prolapsus of the vagina and rectum, the posterior part of the bladder, instead of being carried upwards and forwards, must be drawn downward and backward, and the curve of the urethra must be entirely changed. Instead of presenting a concavity beneath the pubes, as in retroversion, the bladder presents there a convexity, a derangement which must not be lost sight of in the introduction of the catheter.

A case is recorded by Mr. Coley,* of retention of urine caused by imperforation of the hymen. The cause of the ischury was found to consist in imperforation of the hymen, which, by totally preventing the discharge of the menstrual fluid, had produced a mechanical obstruction in the urethra.

The morbid appearances presented after death, in cases of paralysis of the bladder, are dilatation of the organ, attenuation of its coats, and a pale white appear-

* Lancet, 1833, p. 395.

ance of the mucous membrance; these, at least, are the appearances found when the kidneys and the mucous membrane of the bladder have not been seriously involved in mischief, as after injuries of the spine. In the latter case, there is great vascularity of the mucous membrane lining the bladder, ureters, the pelvis, and infundibula of the kidneys; the mucous surface of the bladder is thickened, of a slate colour, and presents, here and there, dark red spots; and sometimes it is covered with phosphate of lime, deposited from the mucus, or a white powder is found in the mucus itself, and the bladder contains some fetid urine.

A few words must here be added upon hysterical affections of the bladder. Although diuresis is the most common symptom in such cases, patients not unfrequently declare they have lost the power of voiding the urine, and that none has passed for three or four days.

That there must oftentimes be something beyond the mere waywardness of the fancy is evident from the fact that patients, the subjects of hysteria, have been known to submit, without complaint, to severe treatment, even the loss of a limb. We may have to deal with a case in which we must be prepared against every shade of duplicity and cunning, in which the love of attention, and the desire of exciting commiseration, will supersede every other passion, and all the remaining powers of the mind will be turned to learning every symptom, and carefully treasuring up every hint, which, brought out at some future time, may serve to perplex the practitioner and revive declining interest. "To become an object of attention,

an interesting object," says Dr. Prout, "is an innate and characteristic feeling of the female mind; and if, in early life, this feeling, in its natural and legitimate form, has been thwarted or disappointed, it is almost sure to deviate into some other channel; and the ruling passion is displayed in attempting to excite pity and commiseration where she cannot excite erotic sentiments." In these and many cases of nervous paralysis from sympathy with other organs the bladder symptoms are often irregular or intermittent; and the patient experiences little real suffering in the region of the bladder unless that organ has become greatly distended.

The treatment of such a case is obvious. The catheter must not be introduced too early. Indeed, these cases, if left to themselves, usually recover; but, if we once begin to pass the catheter, its use will be for a long time required, and the complaint will be protracted. I distinctly recollect a case of this kind, in which the catheter was introduced once or twice a day, for some time, until at last a suspicion was excited that the malady was either feigned or nervous, and that it would be desirable not to introduce the instrument. After this the young woman escaped from my notice; but I learnt that the affection of the bladder soon subsided. As a general rule in these cases, the catheter ought not to be introduced. Care, however, must be taken lest the bladder become truly paralysed, when an effort of the will can no longer be exercised. Morbid changes may then ensue, as in other instances of similar disease.

The diagnosis of retention of urine caused by mechanical or organic obstruction from true paralysis of the

bladder is rarely difficult; for, although the nature of the complaint is seldom revealed by the rational symptoms, we possess in the catheter a means of removing all doubt, and ascertaining whether the mischief depends on loss of power in the muscular tissue of the organ. Should the use of the instrument prove the absence of any mechanical obstacle or disease in the urethra, prostate, and other organs, we are entitled to conclude that the incapability of evacuating the bladder arises from paralysis.

To attain more precise information relative to the condition of the bladder, M. Civiale is in the habit of employing injections, from the use of which he has derived great assistance. After having withdrawn as much of the urine as is possible with the catheter, M. Civiale recommends us to throw in several injections of cold water. The first one dribbles away without force; the manner in which the second injection is expelled, shows some remains of power; and by varying the quantities of the fluid injected, and the intervals between each injection, we obtain much useful information relative to the progress which the disease may have made, and the capacity of the bladder. This applies, of course, to partial paralysis only.

In all cases of paralysis of the bladder, an early attention to the condition of the organ is of great importance. The longer the urine is allowed to remain in contact with the mucous membrane, the more likely is it to excite disease; while the frequent and continued distension of the muscular fibres gradually renders them more lax; elongates and makes them thinner; and

diminishes the chance of our being able, by any treatment, to restore them to a healthy state.

The indications of treatment are sufficiently obvious. Our first care must be to relieve the distended bladder; our next, to restore its contractile power, and remove all such causes as may appear to influence the paralytic condition of the organ.

The accumulated urine is to be drawn off by means of a catheter; and the operation should be repeated at least three or four times in the twenty-four hours (at intervals sufficiently short to prevent over distension), until the bladder has recovered its contractile power. In some few cases, however, less disturbance will arise from allowing the catheter to remain in the bladder than is produced by the repeated introduction of the instrument.

As full a sized catheter as the urethra will admit had better be used; and, if blood is present, the instrument must not only be full-sized, but longer by two or three inches than those usually employed. In old people a large catheter is also necessary, as it develops the calibre of the urethra, the parietes of which, at this time of life, are soft and flaccid; and in retention of urine in persons of advanced age, the bladder frequently ascends above the pubes, and the urethra is elongated, consequently a catheter somewhat longer than those in ordinary use is required.

The curvature of the catheter must be proportioned to that of the urethra, or, at least, in relation to the period of life. The curve of the canal increases from infancy to old age, being greater in the adult than in the infant; while the urethra is most curved in those who are far

advanced in life, an effect produced by increase in the depth of the symphysis pubis. In ordinary cases of retention, I prefer a full-sized silver catheter, mounted on a rough ebony handle, or a gum-elastic catheter, made of such materials as will enable it to retain its shape. The catheter being well oiled and slightly warmed, the patient stands with his back against the wall or a table, or he may lie in the horizontal position, which is sometimes preferable to the former, with the legs and thighs flexed and slightly separated. The surgeon places himself in front or on one side of the patient, and introduces the instrument with its concavity towards the abdomen and pubes; he then propels it gently onwards, through the urethra, till the point has arrived beneath the symphysis of the pubes. The surgeon next depresses the handle of the catheter between the thighs of the patient, and imparts to it a slight degree of pressure, or impulse, to make it enter the bladder, otherwise the beak, in place of passing under the symphysis pubis, will strike against the sub-pubic ligament. This pressure should be very slight; if possible, the weight of the instrument, which can be regulated by not holding it too firmly, ought to be sufficient for this purpose.

When it is necessary to pass the female catheter, it is of consequence to be able to do so readily, which is by no means difficult. The woman ought to be placed on her back, with her thighs separated, and the knees drawn a little up. A basin is next to be placed between the thighs, or a bladder may be firmly tied to the extremity of the catheter to receive the urine. The instrument is then to be conveyed between the

thighs, and the labia and nymphæ being separated with the finger, it is to be run gently under the clitoris, down the fossa leading to the orifice of the urethra, which is easily distinguished, as an irregular depression just above the entrance to the vagina, and higher or lower from its orifice, according as the vagina is in its natural state or retracted. The point of the instrument is to be moved lightly down the fossa after the finger, and it will readily slip into the urethra. It is finally to be carried on in the direction of the axis of the outlet of the pelvis, and the urine drawn off. The catheter may also be readily introduced by placing the point of the finger just on the orifice of the vagina, and the instrument being then glided along the finger, it either at once, or by the slightest motion upward and downward, slips into the urethra. This operation ought always to be performed in bed; and the patient is never to be exposed. In cases of fractures, bruises, &c., where the woman cannot turn from her side to her back, the catheter may be introduced from behind without moving her.

When the bladder is turned over the pubes, as happens in cases of great deformity of the pelvis, it is sometimes requisite to use a flexible catheter, or a male catheter, with its concavity directed forward.

If the passage of a catheter be required in cases of prolapsus and retroversio uteri, the operation is conducted in a different manner from what has been just described; as in these affections the fundus of the bladder is drawn downwards and backwards, there is a corresponding change in the curve of the urethra, the concavity of which is direeted towards the rectum;

from such a change of position, it is evident that the convexity of the catheter should be directed to the pubes; the operator will find it more advisable, in such cases, to use the gum-elastic catheter than the silver one. A contrary effect is produced on the urethra during parturition. If the labour be tedious so as to require the urine to be drawn off, the accoucheur will find the urethra increased in length, and rendered more curved, as the bladder is forced above the pubes by the fœtus and uterus, and the canal thus elongated. The ingenious instrument of Dr. Montgomery will be found useful in these cases.

In paralysis of the bladder dependent on disease or injury of the spine, the catheter should be passed with the greatest care, so as, on the one hand, to avoid injury to the mucous membrane, and, on the other, completely to empty the bladder. On this subject Sir C. Bell makes some good observations:—"When the case is one of injury of the spinal marrow, and paralysis is the consequence, you must," he observes, "be especially careful in passing the catheter. You must pass it slowly, gently, with every possible attention and precaution, and avoid anything like that dexterity, which by French authors is called *tour de maître*. It is especially necessary that you should be cautious in these cases, because there is no sensibility of the part, and you may twitch the instrument, and thereby make an abrasion of the membrane, or so injure the urethra as to lay the foundation for a false passage. Now, it will be found that when a false passage is made, or there has been a ruptnre of the urethra, and the point of the catheter has gone out of the canal, there is the greatest

probability, in introducing it again, that you hit upon the false passage, the edge of the ruptured part being so apt to catch the point of the catheter, and direct it out of the urethra." These are points of the greatest importance, which, perhaps, have not always been sufficiently attended to in practice. Cases are on record in which abscess of the bladder and ulcerative perforations have been the result of the point of the catheter coming in contact with the bladder. I need scarcely observe, that if, from any circumstance, as impermeable obstruction of the urethra or enlargement of the prostate, the catheter cannot be introduced, the life of the patient must not be endangered by delay: the bladder must be punctured.

It is difficult to lay down any fixed rules as to the intervals which should elapse between each introduction of the catheter. I have already alluded to the necessity of avoiding sudden evacuation of a distended bladder. Independently of the danger which may arise from this proceeding, it is more expedient to withdraw the urine slowly, and to close the orifice of the catheter occasionally, for by this plan we excite the bladder to contract and awaken its dormant sensibility. The intervals between each introduction of the instrument will be mainly regulated by the capacity of the bladder, and the degree of the paralytic affection. Generally speaking it will be sufficient to draw off the urine three or four times a day; or, in cases of partial paralysis, whenever the patient begins to experience a desire to empty his bladder. When circumstances render it impossible for the patient to ensure frequent surgical assistance, it will be prudent to leave a catheter

permanently in the bladder, closing the external orifice, so that the urine may be drawn off from time to time. For many reasons, however, the permanent use of the instrument should, if possible, be avoided.

In slight and recent cases, the use of the catheter alone, often suffices to restore the impaired energy of the bladder; but other means may become necessary, in the employment of which, due attention must be paid to the immediate or remote causes of the paralysis.

To arouse the dormant contractility of the bladder, we may employ local stimuli or endeavour to act on it through constitutional remedies. Local means will be found most beneficial when the paralysis is idiopathic; and, in such cases, M. Civiale speaks very favorably of the use of cold injections. They may be had recourse to on the third or fourth day, when the use of the catheter has ceased to excite any irritation about the neck of the bladder. Tepid water is employed for the first injection, from three to four wine-glassfuls being the quantity usually employed. The temperature of the water is gradually lowered to about 60° Fahrenheit; and as soon as the patient is able to bear the contact of the cold water without pain, two or three injections are thrown into the bladder, the one immediately after the other. These have frequently the effect of exciting the bladder to contract; and this once obtained, the case progresses favorably. In some mild cases, one or two injections a day continued for a couple of weeks ordinarily suffice; and an improvement is manifested on the second or third day. Generally speaking, however, the injections must be continued from fifteen to thirty days, care being taken to throw in only one injection

at a time towards the end of the treatment, and omit them for two or three days, according to the effects produced. In severe cases, lavements of cold water must likewise be employed.

When the urine is alkaline, and loaded with adhesive mucus, injections containing a small proportion of nitric acid, will be of great use. I shall speak more particularly of this plan, in the chapter on chronic inflammation of the mucous membrane. Of the medicines likely to produce an effect on the contractility of the bladder, strychnine, and the ergot of rye, have been found most beneficial.

Dr. Baly has employed strychnine internally in paralysis of the bladder, at the Hôpital de la Pitié, and has obtained from its use very decided benefit. Three patients were cured in less than a month by this remedy, given in doses of one tenth of a grain two or three times in the twenty-four hours. M. Petrequin has likewise related several cases illustrating the benefit of the same remedy in paralysis of the bladder, ensuing as a consequence of injury to the spine.

The well-known influence of ergot of rye in creating contraction of the uterus, naturally led to the employment of this remedy for paralytic affections of the bladder. M. Allier was one of the first writers who directed attention to its use in cases of idiopathic paralysis, and his experience has been confirmed by Dr. Day.

When connected with disease or injury of the spine, with cerebral affections, or any serious disorder of the nervous system, paralysis of the bladder seldom admits

of cure. All that we can do in these unfortunate cases is to relieve the bladder with the catheter, and cautiously endeavour to promote natural contraction in its muscular fibres. Small doses of strychnine may be employed with this object; I have little reliance on the use of blisters, moxas, cantharides, and other irritating means which have been recommended. It is, however, right to mention that counter-irritation over the lower part of the spine has been highly extolled by many good authorities, and that the tonic effects of cold douches, sponging, &c., over the region of the bladder, may be had recourse to with benefit.

Although paralysis of the bladder frequently depends on some lesion of the nervous centres, on some mechanical impediment to the discharge of the urine, or on causes of a similar kind, it is certain that the complaint may be idiopathic and essential; that is to say, dependent on want of contractility in the muscular fibres of the bladder itself. The nervous influence arrives at the bladder, but the muscular fibres refuse to obey the impulse. This condition frequently arises from simple over-distension of the bladder in healthy or nervous individuals; and analogy would lead us to conclude that electricity, which powerfully excites muscular contraction, should not remain without effect in cases of this kind. Even in cases of secondary paralysis, where the complaint has been produced by derangement of some distant part, the contractile power of the bladder is not always restored on removal of the original exciting cause. The axiom *ablatâ causâ, tollitur effectus*, does not hold good here, for the nervous complaint has

become localized, just as certain cutaneous eruptions may remain permanent, although the disorder of the stomach, &c., which excited them, has long disappeared.

In paralytic affections of this kind electricity has been recently applied with some remarkable results.* M. Michon has published several cases cured by this agent.

I have already mentioned that paralysis of the bladder is often attended by a sluggish or even paralytic condition of the rectum and lower portion of the intestinal canal. The persevering use of purgative remedies is hence indicated, not only because they stimulate the bladder to action, but from their effect in removing anything which may give rise to mechanical obstruction about the neck of that viscus. Aloetic purgatives are the best which can be employed, and their action should be kept up, not only until the lower bowel has been completely evacuated, but until some effect is produced on the neighbouring organ. Turpentine enemata may also be occasionally employed for the same object, and with considerable benefit. Many other indications of treatment may arise; the cause of the vesical paralysis must in each case be met with appropriate remedies; but I have not thought it necessary to enter on these branches of the subject, which, in fact, belong to general therapeutics.

* See M. Michon, Bull. de Thérap., t. 39, p. 348.

CHAPTER V.

INFLAMMATION OF THE MUCOUS MEMBRANE OF THE BLADDER.

Acute inflammation of the mucous membrane of the bladder is always a severe disease, and often attended with danger. It occurs under a variety of circumstances, to which attention should be paid, for not only the appearance and progress of the malady, but its termination will be modified by the causes which give rise to the attack, and the circumstances attending its development.

The disease may be confined to a small part of the mucous membrane, or spread over a great portion; it may be idiopathic, but this form is comparatively rare; the badder resists many influences which would inevitably excite acute inflammation in other mucous membranes. More frequently by far the disease is produced under the influence of causes which are sufficiently obvious. In many cases the acute attack supervenes on chronic inflammation of the mucous membrane, which has already existed for a considerable time; in others, the inflammation has extended from the urethra, or from some of the pelvic viscera. External violence, wounds, &c., may be the exciting

cause; and in general, most of those causes which I noticed as producing irritability of the bladder. This we can readily understand, for the causes of irritation, when they act with energy, often excite inflammation also. Calculus may thus become an exciting cause of the disease; or retention of urine. When this latter accident depends on partial loss of power in the bladder, the acute inflammation which sometimes supervenes is of a dangerous character; and it is also formidable, when it sets in during chronic inflammation of the organ. The severity and extent of the inflammation arising from wounds and other external injuries will mainly depend on the nature of the wound and the circumstances under which it has been inflicted. The health of the patient at the time of attack will also exercise considerable influence in determining whether the cystitis shall be partial or diffused over the whole mucous membrane. It is on this account, perhaps, that the inflammation which succeeds lithotomy so often proves fatal; but I am inclined to refer this form rather to general inflammation of all the coats of the bladder than to inflammation of its mucous membrane alone.

Inflammation of the bladder, as I have shown, may be connected with, or dependent on, several other morbid states of that organ. It is, therefore, necessary to distinguish the essential symptoms of the disease from those which may be called accidental, inasmuch as the accidental symptoms arise from the morbid states which contributed to the production of the complaint.

The essential symptoms of acute cystitis are severe

pain over the region of the bladder, accompanied by frequent and irresistible desire to pass the urine, which is voided at short intervals and in small quantities; the bladder forms a small, rounded, and firm tumour, which is exceedingly painful to the touch, whether pressure is made over the pubes or through the rectum; the pain and irritable condition of the bladder are attended by fever and other constitutional disorders of a severe kind.

Unless it supervenes on the chronic form, acute inflammation of the bladder generally commences in a sudden manner, and runs a rapid course. The patient first experiences some pain in the region of the bladder; this is quickly followed by constant desire to make water, and these two symptoms rapidly increase until they acquire a most distressing degree of intensity. The pain is first experienced above the pubes, and may be dull for a short time; but it soon becomes violent and extends along the urethra, shooting into the perinæum and down the thighs. Pressure over the pubes or on the perinæum greatly increases the pain, and if the posterior wall of the bladder be examined by introducing the finger into the rectum, it will be found that this part of the organ also is extremely sensitive.

The discharge of urine takes place frequently, for the desire to make water becomes more and more urgent as the disease advances; there is a sense of heat and burning along the urethra, and the pain felt in passing a few drops of urine is often compared by the patient to the passing of molten lead. At the early stage, the pain subsides after the urine has ceased to flow, but it returns as soon as a small quantity of fluid collects in

the bladder. The mucous membrane, in fact, soon becomes altogether intolerant of the contact of the urine; and the agony thus produced, together with the incessant and irresistible calls to evacuate the organ, are valuable diagnostic signs of acute inflammation. The irritability of the bladder is communicated to the rectum, and tenesmus is, also, a frequent symptom.

The condition of the urine varies with the stage of the disease; it is at first mucous, then tinged with blood during the height of the disease, and, in many cases, purulent towards the end. I shall recur to these conditions again.

Whenever the inflammation is severe, and occupies any considerable portion of the mucous membrane, constitutional symptoms, as we might expect, quickly set in. Symptomatic fever is developed, severe in degree, but often of a nervous character, and attended by great disturbance of the digestive organs. Hence, vomiting frequently occurs, and the patient is a prey to nervous symptoms of a very distressing nature.

After a few days, unless the disease be arrested, the local symptoms acquire an extraordinary degree of severity; the pain is constant and of a most distressing kind, being accompanied by incessant efforts to empty the bladder, which the patient is unable to accomplish; the urine comes away by drops, and the bladder gradually loses its expulsive power, though aided by violent contraction of the abdominal muscles. A firm, painful tumour may, now, often be felt above the pubes, for retention is succeeding the incontinence produced by irritation; the sufferings of the patient carried to their highest pitch, may appear to subside a little; but this

is deceptive; the character of the fever changes; the countenance becomes anxious, and the features sunken; general prostration increases rapidly; low delirium sets in; there is often hiccough; the pulse becomes weak, irregular, and then intermitting; the skin is covered with a clammy perspiration; and the patient finally sinks about the eighth or tenth day in a state of prostration or absolute coma.

Such is the general history of acute inflammation of the bladder in its most severe form; but when less violent in its nature, or when confined to a limited portion of the mucous membrane, the disease may terminate in ulceration, to which I shall presently recur.

The condition of the urine requires some further notice. It is generally acid, and varies in appearance, being sometimes of a lemon colour; at other times of a deep red; and on examination in a transparent vessel by the light, numerous shreds of lymph, or mucus, are seen floating in it.

Sometimes there is a deposit of a large quantity of deep orange red or yellow sediment, consisting of imperfectly developed urate of ammonia, the urine being more or less serous. These and other varieties in the appearance of the urine depend on the state of the kidneys and mucous membrane of the bladder, and on the immediate exciting cause of the attack. It is remarkable that whatever may have been the nature of the preceding symptoms, or the properties of the urine, it almost always becomes acid before death. At first the urine is not albuminous, but it may become so from extension of the disease along the ureters in the progress of this as well as of other inflammatory affections

of the bladder. It is discharged in very small quantities, though the average in twenty-four hours may equal the usual quantity.

If the inflammation be extremely violent, the secretion of vesical mucus may be suppressed altogether; but, in many cases, the urine contains, at an early stage of the complaint, a quantity of thick, ropy mucus. Soon afterwards it becomes tinged with blood; and during the height of the disease actual hæmaturia has been frequently observed. In other cases, whether from extension of the inflammation to the kidneys, or from ulceration of the mucous lining of the bladder, the urine contains purulent matter.

The morbid appearances of acute inflammation of the bladder are the same as those produced by acute inflammation in other parts of the body. We find, as in cases of enteritis, inflammatory injection and softening of the mucous membrane; ulceration; secretion of lymph or pus; and sometimes gangrene. In a state of inflammation, the mucous coat of the bladder, naturally soft, pale, and semi-transparent, becomes thick, rough, and of a reddish pink colour from the distension of a multitude of delicate blood-vessels, some of which give way and thus give rise to small spots of extravasation or ecchymosis. The inflammation may extend over the whole inner surface of the bladder, or be limited to some particular part of it; most commonly, that part which adjoins the neck of the bladder is found in a state of inflammation. The coagulable lymph, which sometimes in these cases covers the inner lining membrane, has been found projecting in shreds into the cavity of the bladder; and during life portions of it have

been occasionally separated and discharged by the urethra.

In some cases flakes of lymph are effused upon the mucous surface, forming a false membrane in a continuous layer; ulceration may have destroyed the whole mucous membrane, or is sometimes confined to a particular spot, and has formed a fistulous communication with the rectum or other neighbouring viscera. Upon the ulcerated surface we may find calcareous matter deposited in grain-like sand, or in small flakes.

It is frequently difficult to decide as to the existence of ulceration; but there is always reason to suspect it when disease of the bladder has been of long continuance, and the pain is extensive and increasing. The ulcerative process is attended with constant pain and irritation, keeping up the desire to void the urine, which is never suffered to accumulate; while, at the same time, increased difficulty and pain generally attend micturition.

The walls of the organ generally become thickened, and the muscular fibres, denuded of their mucous covering, stand out in strong relief. Cases are recorded in which ulceration has extended so deeply into the substance of the bladder, as to cause perforation of its parietes and extravasation of urine into the abdomen. In these cases, life is soon destroyed by peritoneal and cellular inflammation. But when the ulcerative process extends to the other tunics of the bladder, it usually happens that it is accompanied by effusion of lymph, from adhesive inflammation exterior to the ulcer, by which process the bladder becomes united to the neigh-

bouring parts, and the escape of urine is prevented. In this manner, a communication is sometimes formed between the fundus of the bladder and the ileum or the sigmoid flexure of the colon, or between the under surface of the bladder and the rectum; in the former of which cases, the fæces pass into the bladder, and through the urethra; while in the latter the urine passes into the rectum, and is voided with the fæces.

Mr. Wilson* says, "I have preserved the bladder and ileum of a person, which had adhered fifteen years before the death of the patient. Ulceration to a large extent had taken place in this connected part; and for the whole of the above-mentioned period, the feces readily passed from the ileum into the bladder. The patient died when sixty-eight years of age. Being a female, the shortness of the urethra had allowed the substances which passed into the bladder a tolerably free escape, and no calculus formed."

Ulceration between the bladder and rectum is not a very rare occurrence. I was requested to see a gentleman, æt. sixty-two, in whom the feces found their way into the bladder, and were passed by the urethra. He complained of frequent desire to make water, which was attended with smarting and scalding during its passage. He had also great distension about the lower part of the abdomen. Micturition was usually followed by severe darting pains at the end of the penis, and by the escape of flatus through the urethra. The urine, which was acid and albuminous, contained much feculent matter, with a good deal of mucus. It was clear,

* 'Lectures on the Urinary Organs,' p. 317.

that in this case, there existed a communication between some portion of the intestinal canal and the bladder, through which the feces passed; and, during their evacuation, the pain was intense. The bowels were pretty regular; the motions were often solid; and their passage was not attended with pain. The treatment which was adopted, consisted in the use of suppositories and other sedatives, so as to keep the rectum and bladder in as quiet a state as possible. Some time after, when the fistulous opening seemed to be closed, and the general health was much improved, hæmoptysis occurred. During the treatment pursued for the relief of this attack, there were constant feculent discharges from the bladder attended with great exhaustion.

After this attack, the balance of the circulation was never restored; tympanitis occurred, with distension of the colon to an enormous magnitude; ascites followed the inflation of the colon, serous diarrhœa and anasarca supervened, and in a few months afterwards the patient expired. For some weeks prior to death, the escape of feces through the bladder had altogether ceased.*

On dissecting back the integuments, and laying them open, the colon presented the appearance of a large tromboon, amazingly distended, and stretching across the umbilical region, with its sigmoid flexure, equally large in the left iliac fossa. The space above its line was occupied by an enlarged liver, and that below by the small intestines. The omentum was shrivelled, and drawn across to the right iliac fossa, where it was

* Vide Guy's Hospital Reports, No. xiii, p. 405.

adherent to the parietes above the internal abdominal ring. The peritoneum was universally opaque and injected. The sigmoid flexure of the colon, the ileum, and the cæcum, with its appendix, were each and all adherent, *en masse*, to the fundus of the bladder, and involved in a general thickening of the surrounding textures. The bladder, with the adherent intestines, was removed, and a particular dissection revealed the following appearances.

The colon hypertrophied, singularly muscular, and in circumference about the size of a man's arm, was together with a convolution of the ileum, and the appendix cæci, adherent to the fundus of the bladder. The natural calibre of the gut was impeded by a contraction or stricture, which commenced inferiorly in the rectum, about a fore-finger's length from the anus (just at the base of the triangle formed by the vesiculæ seminales), and extended upwards for about two inches, barely admitting the entrance of the little finger. A section of the gut in this part resembled scirrhus: and the glands were, with the surrounding tissues, thickened immediately above this stricture; the coats of the bowel were studded with ulcerations and openings, leading into a channel which separated the bladder from the intestine. This channel was, in fact, a fecal abscess, situated beneath the reflected portion of the peritoneum, between the bladder and bowel. It was degenerate in structure, lined with a dark membrane, and filled with a muco-purulent secretion. It opened anteriorly into the fundus of the bladder; above, into the colon; below, into the rectum; and posteriorly, through the colon into the ileum; so that there was a

false passage, by which the natural course of the colon was diverted, and forced between the bladder and strictured part of the intestine down into the rectum below, and at the same place, by means of a fistulous opening into the bladder, in front. The orifice of this fistulous opening within the bladder was curtained by a fungous growth or thickening which overhung it like a valve. Thus, exactly at this point of the fecal abscess, there was this strange lesion, the colon, the rectum, and the ileum—each, conjointly with the fecal abscess, possessing one common entrance into the bladder itself. Within the bladder, the rugæ of the mucous membrane were vascular, and the muscular coat was considerably hypertrophied.

In another case which I attended, a communication existed between the fundus of the bladder and the colon, just above a stricture in the sigmoid flexure. The patient complained of a deep-seated dull pain in the lower part of the abdomen, extending from the pubes to the sacro-iliac symphysis on the left side; he said he had been affected with pain in the bowels for nearly twelve months: and he also complained of considerable uneasiness in the urethra, and of a burning sensation towards the extremity of the penis. The urine was high coloured. On pressing the hypogastric region with firmness, he suffered considerable uneasiness; his tongue was dry, a little furred, and of a brownish hue; his pulse was quick, about 110, and rather firm. He was bled from the arm to eight ounces; a dozen leeches were applied to the perinæum, and a blister to the lower part of the abdomen; a purgative was administered. On the following day, the pulse

was softer, and the urine high-coloured, with a very considerable deposit of a purulent kind, and of a very fetid smell. Liquor potassæ and extract of hyoscyamus were then given. On the following day, the urine contained a considerable quantity of feculent matter, which led me to conclude that there must be ulceration of the intestines. Flatus was also passed through the urethra; stools, voided per anum, were always loose, and the patient said he had not passed a solid stool for a considerable time. On examination per rectum, the finger could not reach any ulceration or stricture; and it appeared that no urine had ever passed per rectum. The pain and uneasiness increased; and the treatment was confined to giving various forms of opium. The strength of the patient gradually decreased, and he died worn out by his sufferings. On examining the body a stricture was found in the sigmoid flexure of the colon, and above the stricture there existed slight adhesion with the fundus of the bladder, towards the left side. There was an opening through the stricture, about the size of a goose-quill, through which some feces passed into the rectum; but from the narrowness of this orifice, it was impossible that any solid feces could pass. Two inches of the intestine above the stricture, as well as part of the fundus of the bladder, appeared gangrenous, and in a state approaching to sloughing; the coats of the bladder were thickened; the bladder itself was not bigger than a large orange; and from being much thickened, it appeared incapable of further distension.

This case is a good illustration of the effort which the system at times makes to evacuate what is ex-

traneous by the most direct passage when there exists an obstacle to its expulsion in the natural way; and is strictly analogous, pathologically considered, to what we sometimes see occurring when an abscess forms in the liver. There we find adhesion first taking place between the liver and duodenum or colon; and by means of the ulcerative process which follows, the matter of the abscess is evacuated by the gut.

The more usual course, however, is, that ulceration gradually extends over a considerable portion of the mucous membrane, and then the muscular structure is shown more clearly than any dissection can exhibit it. In the progress of the ulceration, disease commonly manifests itself in one of the kidneys; and, as far as my observation goes, more frequently in the left. This is indicated by pain in the loins on pressure (for the pain is never severe), by shiverings, sickness, and the albuminous state of the urine. At this stage, large quantities of pus are voided with the urine, and the latter is tinged with blood.

With ulceration of the mucous coat there is generally combined hypertrophy of the muscular coat, and a contracted state of the bladder. The urine, no longer contained in a viscus capable of dilatation, partly escapes involuntarily by the urethra, and is partly thrown back upon the ureters, which become dilated and tortuous. The mucous membrane, extending upwards along the ureters to the pelvis and the infundibula of the kidneys, becomes inflamed and rough, and pours forth a quantity of pus. The glandular structure of the kidney undergoes from pressure slow absorption. The capsule adheres with preternatural firmness to the exterior of the

gland. Upon making a section of a kidney so diseased, we find that, although apparently of large size, it consists in great part of dilated tubes, and that the true vascular or secreting part is in smaller proportion than usual.

When pus and mucus exist in the urine in small quantities, it is difficult with the unassisted eye to distinguish one from the other. Pus, however, may be distinguished from mucus, when diffused through a fluid, by rendering the latter opaque. Upon standing, the pus subsides to the bottom of the vessel, and the fluid resumes its transparent character. If mucus be present likewise, the pus is found lying on the mucus, and presents a much yellower tint; it is also quite opaque, whereas mucus is more or less transparent.

The microscope affords at once the most ready and certain mode of detecting the presence of pus in the urine. The pus-globule is spherical, and granular on the surface; its diameter is $\frac{1}{2500}$th of an inch. If the urine be acid the nucleus of the pus corpuscle may be seen without the aid of reagents. Should, however, the peculiar shaped nucleus not be clearly detected before the addition of acetic acid, a drop of that fluid, by rendering the envelope of the corpuscle transparent, will instantly bring it into view. The characteristic nucleus of the pus globule is ordinarily tripartite, sometimes quadripartite, more rarely only bipartite; each division of the nucleus is biconcave, and measures about $\frac{1}{8000}$th of an inch in diameter.

The only bodies with which the pus corpuscles, when passed in considerable quantity with the urine, can be

confounded, are young epithelium scales. These, however, are readily distinguished by their solitary nucleus; although a pus corpuscle may occasionally be found in which only one undivided nucleus is to be seen, it will be lost amid the numbers which present their normal tripartite nuclei. As to the mucous corpuscle, there is no proof of its existence; under that name have been confounded pus corpuscles seen without the use of reagents, the pyroid corpuscles of Lebert—really a variety of compound granular corpuscles—young epithelium scales and the nuclei of epithelium scales.

The use of the microscope has rendered all other tests of comparative trifling value. The two previously in use were the chemical and the optical. If pus be agitated with equal parts of warm water and a saturated solution of carbonate of potash, a viscid transparent compound is formed: mucus similarly treated becomes thinner. If a drop of pus be placed between two slips of glass and then held up to a candle, a circular corona of colour is seen around the flame, a red area surrounded by a circle of green. The power of thus refracting the rays of light is due to the presence in the pus of the globules above described; consequently, if pure mucus be treated in the same manner, it fails to produce the same effect. Sometimes, however, mucus contains a sufficient admixture of heterogeneous particles, to give rise to a reddish area around the flame.

A copious sediment apparently resembling pus, is sometimes produced by the presence of triple phosphate in the urine. The nature of the deposit is shown by

the rapidity with which it is dissolved in nitric acid, and by the shape of the crystals when a little of the fluid is placed beneath the microscope.

Urine containing pus may have an acid or an alkaline reaction. In the former case the pus ordinarily owes its origin to pyelitis, in the latter to cystitis. If urine, very turbid from the presence of pus, be allowed to stand for a while it becomes clear, and throws down at the same time a more or less abundant sediment; the supernatant fluid frequently has a peculiar greenish yellow tint, and contains albumen.

The neck of the bladder is the most sensitive part of that organ; and hence, probably, the mucous membrane in the neighbourhood of the neck is most liable to inflammation and its consequence—ulceration.

In Dr. Baillie's plate of ulceration of the mucous surface, the ulceration is shown to proceed from the fundus towards the neck; but in a specimen which I possess, and in which only part of the membrane is destroyed, it commenced at the neck: and I have lately seen many preparations illustrating the same fact. In the examination of the bladder we should always remember that ulceration may be connected with the presence of a calculus.

I have seen a case in which after death the whole mucous membrane was found separated in a smooth grayish white continuous layer. It appeared to have sloughed away during life, and to have separated from the surrounding muscular tunics. At first it might have been taken for a false membrane of organized lymph; but upon closer inspection it was seen to possess traces of the normal structure. The bladder,

when first divided, seemed to contain a large cyst or bag of hydatids; for the yellow membrane protruded through the cut surface, partially distended with urine. It was attached to the muscular coat both at the neck of the organ and at the entrance of the ureters, where the mucous membrane was red and congested, and more loosely connected than natural to the adjacent structures, but not deprived of vitality. Under the microscope the well marked fibres of areolar tissue were seen, in which, however, the yellow elastic tissue prevailed; the white fibres having in great part undergone decomposition. In most of the cases which I have dissected, the whole of the membrane has been removed by ulceration. Sometimes, however, round ulcerated spots, of the size of a sixpence, are found in different parts with elevated edges and a red surface, the muscular structure not being seen, and the remaining membrane being very vascular. The ulcers, when small, are not unlike primary syphilitic sores, from their excavated surfaces and raised margins.

If the inflammation reach a high degree, the muscular coat is also attacked, presenting here and there gangrenous spots, or even being completely destroyed by it. But, as the muscular is connected but loosely to the inner membrane of the bladder, the inflammation does not easily pass from one to the other.

Acute inflammation of the mucous membrane of the bladder cannot easily be confounded with any other affection of that organ. This applies especially to idiopathic cases; for in others, connected with the presence of foreign bodies, &c., in the bladder, the

symptoms arising from the cause may, in some degree, mask those which depend on the inflammation thus excited. It may be more difficult to distinguish inflammation of the mucous membrane, from inflammation of the deeper-seated tissues. Many surgeons deny the possibility of our drawing such a distinction, and, in a practical point of view, it is not of very great importance; but when the muscular tissue is chiefly involved, I have observed that the power of passing urine does not exist, and the desire to void it is less frequent, as it is not experienced until a good deal of urine is accumulated in the bladder, and then comes on in violent paroxysms. Neither is there the burning sensation along the urethra which is felt when the mucous membrane alone is affected.

The disease may sometimes be mistaken for stone. The uneasiness in the bladder, the frequent desire to make water, and the passage of blood with the urine, are symptoms of stone as well as of this affection. But in stone the pain is principally experienced after the bladder has been emptied, whereas, in acute inflammation of the mucous membrane of the bladder, the pain is most intense when the bladder contains urine, and it subsides when that viscus is empty: in stone, also, larger quantities of blood are passed than in this disease, and the urethra is seldom so irritable.

Acute inflammation of the mucous surface of the bladder is a formidable disease, though if taken in time, and treated with energy, it often yields under appropriate treatment. It is a great object to prevent the inflammatory process from extending to the deeper seated tissues, or to the ureters; and this can only be

obtained by the free abstraction of blood at the onset of the disease. Whenever the general state of the patient is such as to admit of venesection, blood should be drawn freely from the arm. The abstraction of blood must be repeated if necessary; but on this point nothing beyond general rules can be laid down, for the surgeon must be guided, not only by the impression which bleeding may have produced on the disease, but also by the particular circumstances of each case. Commonly, however, repeated bloodletting cannot be borne. The general abstraction of blood must be followed up by free local bleeding, by leeches, or cupping. Dr. Prout recommends us to apply the leeches to the perinæum, and this may be advisable if the inflammation, as is often the case, appear to be confined chiefly to the neck of the bladder. But the patient may complain of severe pain over the pubes, or in the loins, and in such cases I would prefer applying the leeches over the points which are most sensitive; a few hours after the bleeding, the patient should be placed in a warm bath, which must be kept at an uniform temperature of about 90°; the baths are to be repeated every day for three or four days; and in the intervals relief will be obtained from the application of warm fomentations to the abdomen, just above the pubes.

At an early stage morphium, or opium, (I prefer the former,) is a most valuable remedy, given in sufficient doses to allay the pain about the bladder and along the urethra, as well as the frequent desire to pass urine. These are the most distressing symptoms; and if not mitigated, they soon wear out the strength of the

patient; but if even a few hours' intermission be obtained in the day, some chance may exist of recovery.

In addition to the internal use of opium, or morphine, anodyne injections, or suppositories, should be exhibited at bed-time; and great relief will be experienced from their use. As a constitutional remedy Dr. Prout recommends active doses of calomel, conjoined with opium; and from the well-known influence of calomel in checking the acute dysenteric inflammations of warm climates, it is likely that mercury administered early may exercise a controlling power over the disease.

It is almost unnecessary to mention that the bowels must be kept gently open by the mildest laxatives. The effect of any irritation in the lower intestines on the bladder, obviously points to the expediency of clearing them out with castor oil or any other gentle laxative. Stimulant injections into the rectum must, for the same reason, be carefully avoided.

Some practitioners recommend the injection of oil and opium, and other remedies, into the bladder, by means of a gum-elastic catheter. In one of my patients, this plan had been tried, at the suggestion of an eminent physician, prior to the patient being placed under my care; but no benefit was derived from the treatment.

M. Civiale justly remarks that one of the most important points in the treatment of acute inflammation of the bladder, is to keep the organ in a state of as perfect repose as possible. If the functions of the bladder could be completely suspended, and the contractions necessary

for the expulsion of urine avoided, the disease would lose a great part of the danger which accompanies it. Hence we must carefully watch the condition of the bladder, and as soon as urine begins to accumulate, even though the patient experience no great desire to make water, an instrument should be introduced. This is excellent advice, and should be followed, whenever any symptoms of retention of urine manifest themselves; but the great pain and irritation produced by the passage of any instrument along the urethra are so severe, that I should be deterred from employing the catheter with the sole object of keeping the bladder empty. When the active symptoms have abated, it will be advantageous to apply counter-irritation above the pubes.

In the treatment of these cases, however, we find that no remedy, opium or morphium perhaps excepted, long retains any influence over the disease. The practitioner must be provided with a variety of agents, so as to be ready to substitnte one for another when it loses its effect. Infusion of diosma in the proportion of an ounce to a pint of water, small doses of copaiba and essential oil of cubebs, infusion of hops, and the alkalies, will, all in their turn, be found useful.

To the diet of the patient the greatest attention should be paid. Animal food, wine, spirits, and acid drinks, should be interdicted; the diet should be light, consisting of bland, farinaceous food; and the drink should be water, toast-and-water, and linseed tea; but not to such extent as to increase, in any very considerable degree, the secretion of urine. The patient should also be kept as quiet as possible, and in a rather warm temperature.

The prognosis of the disease is very unfavorable if the ulcerative stage once sets in. This is usually indicated by the continuance of the pain of the bladder on motion, and in making water. If, therefore, the pain be not early subdued, little hope can be indulged of a successful termination. By judicious management, life may be prolonged for some time, but the patients are seldom cured, the bladder being in a state unfit to perform its functions, and the morbid changes having extended along the ureters to the kidneys. When the inflammation spreads to the mucous lining of the ureters, the pelvis, and tubular structure of the kidney, it is attended by a profuse discharge of mucus, purulent matter, and epithelium.

If a female (and females have been said to be more subject to this complaint than males) labouring under the disease, becomes pregnant, the symptoms are greatly mitigated, and the fatal termination for a time averted. I examined the body of a French woman, who, immediately after delivery, was attacked with all the symptoms above mentioned, and died within a week from the attack. The inner membrane of the bladder was found to be completely destroyed. I could not obtain any accurate account of the case; but I learnt that the patient, during the few days she was in the hospital prior to delivery, did not complain of the affection of the bladder. One case, however, I watched from the commencement of the disease (which occurred a month after marriage) till the death of the patient, which took place a month after delivery. During the latter half of pregnancy, the symptoms were much milder than before; but, soon after the birth of the

child, they returned with their accustomed severity, and destroyed the patient.

I was requested to visit Mrs. M., æt. 36, who was supposed to be labouring under symptoms of stone. She had frequent desire to make water, and shooting pains in the region of the bladder, much increased by walking, and exercise of every kind. The urine was acid, and contained some shreds of lymph or mucus. No blood or gravel had been passed. On sounding the patient, the instant the instrument was introduced into the urethra, the pain became much aggravated. No stone could be felt. The pulse was small and quick, the skin dry and rough, the tongue white, the countenance anxious, and indicative of much suffering. I expressed an unfavorable opinion of the case, believing, as I then stated, that there was ulceration of the bladder. She had been in this state two months, and various remedies had been tried. I suggested the use of pareira brava, first in the form of infusion, then in that of decoction. For the first six weeks leeches were occasionally applied to the hypogastric region, tartar emetic ointment rubbed in, and at night a thin starch injection, with twenty minims of Battley's sedative solution, was given. Mrs. M. then tried the decoction of pareira brava, which she continued till about two months prior to her death, when, perceiving more mucus in the urine than usual, and occasionally blood, I added a small quantity of balsam of copaiva to the mixture. This brought on sickness and deranged the stomach so much that thenceforward she was obliged to desist from the decoction. She now had sickness and nausea; pus was voided with the urine; there were

complete loss of strength, emaciation of body, and hectic flushes; and six months from the time I first visited her, death put an end to her sufferings. It should be observed that, for a few days prior to death, no pus had been voided with the urine, and the pain and frequent desire to make water, for the only time during her long illness, had almost subsided.

The body was examined within forty-eight hours after death. The bladder was not thickened or contracted, but completely divested of its mucous membrane. No dissection could exhibit the arrangement of the muscular structure so well as it was seen in this case. One spot, the size of a shilling, towards the fundus, was black and almost gangrenous. The ulceration had not extended to the urethra; but its lining membrane was highly inflamed. The right kidney was in its natural state, but the left kidney was ulcerated, and its interior filled with pus. The renal extremity of the left ureter was blocked up by a detached portion of the substance of the kidney.

Deborah Mulloday, æt. 46, complained of great uneasiness, pain in the lower part of the belly, and frequent desire to void urine. After the bladder was emptied, the pain and uneasiness usually subsided. These symptoms were at first relieved by the use of the decoction of pareira brava. The pain became very acute, the desire to make water more frequent; the urine contained a good deal of pus; and, on two or three occasions, it was tinged with blood. The pulse was small and quick; the countenance pale and sallow; and there was emaciation of the body, with occasional shiverings and cramps. She had no pain in the loins, and there was

no sickness until about ten days prior to her death, when it was very distressing, and of some days' continuance. On Friday, July 26th, she was seized with paralysis, and expired on the following Tuesday. Twenty-four hours after death the body was examined. The mucous membrane of the bladder was ulcerated in several spots, but was not so extensively destroyed as in the preceding case. The bladder, which was thickened and contracted, contained a good deal of pus. The right kidney was in a state of atrophy, and chalky matter was deposited in its interior. The urethra was inflamed, but not ulcerated.

George Scandreth, æt. 56, tailor, complained of frequent desire to pass urine, of great pain in passing it, a scalding sensation in the urethra, and of pain above the pubes and across the loins. The urine was high-coloured, and contained numerous fine shreds of lymph; it was also acid, scanty, and albuminous. I ordered some soothing remedies which, for a time, diminished the pain but had no other effect upon the disease. The patient became gradually worse, and in two months he died. On examination, I found the mucous membrane of the bladder almost completely destroyed, minute filaments hanging loosely from its inner surface; the bladder contracted in size, and a little thickened; the lining membrane of the urethra highly inflamed and ulcerated about the membranous portion; the prostate not enlarged; the left kidney in a state of ulceration, and containing pus. I have the preparation in my possession.

William David Sadler, æt. 17, of a delicate constitution, and light complexion, applied at the General

Dispensary, labouring under an affection of the bladder. He said that about seven months previously, in making water, he first felt pain, which lasted for some minutes, and then disappeared. Since that time, this symptom had never left him. Occasionally he was suddenly seized with a darting pain near the neck of the bladder, accompanied with an irresistible desire to make water, after which the pain subsided, and he felt easier. These attacks varied in frequency—sometimes occurring every hour or oftener, at other times at longer intervals. The urine was turbid, voided in small quantities, and extremely acid. The appetite was good; the general health not much deranged; the pulse quick; the tongue white and dry. Two or three times a sound was introduced, with great pain, but no stone could be felt. Alkalies and hyoscyamus; small doses of cubebs, with carbonate of potash; the decoction of pareira brava alone, and in combination with small doses of copaiba, mucilage, and hyoscyamus, were tried, but without benefit.

The patient escaped from my notice; but he died a short time afterwards, and I was informed by the medical man who examined the body, that there was ulceration of the bladder and disease of the left kidney.

Charlotte Mason, æt. 56, a married woman without family, and subject to pains in the limbs, was seized, in the month of March, with frequent desire to void urine, always attended with great pain, and a burning heat in the urethra; the pain continued for some time after the urine was passed, so that she could scarcely stand or sit down; she had great pain in her back and the lower part of the abdomen, headache, and at times

pains in the left hip and leg, great weakness, trembling, and general debility. During the night she was generally obliged to micturate four or five times: the urine was alkaline, of a light straw colour, and latterly contained a good deal of pus. The disease resisted all the remedies which I could devise. Morphine alone gave her relief. She gradually lost flesh and strength, and died on the 30th of the following December. I examined the body, and found the whole of the mucous membrane completely destroyed by ulceration. The left kidney was also in a state of ulceration, and the lining membrane of the left ureter, to the extent of two or three inches, close to its vesical extremity, was thickened and lined with coagulable lymph.

In these cases there was evidently something more than simple ulcerative inflammation of the mucous membrane; but I have related them because they seem to me instructive.

Dr. Prout, in alluding to these cases, considers them nearly allied to irritable bladder dependent on organic mischief in the kidney. "The urine in these cases," says Dr. Prout, "is generally acid, of a pale greenish whey-like colour; opalescent, from the presence of minute epithelium or mucus; of low specific gravity (that is, generally below 1·020); often serous, but rarely bloody. Sometimes, on being heated, it deposits the phosphates; but the urate of ammonia is seldom so abundant as to be spontaneously separated on the cooling of the urine; and when this circumstance does take place, the colour of the sediment, instead of being yellow or red, is usually of a greyish ash tint. After standing for some time, the urine becomes clearer, but seldom acquires

perfect transparency, even by filtering; and the peculiar sediment in general is very easily remixed on shaking.

"In conjunction with these appearances of the urine, the patient usually complains of the following symptoms: there is a frequent and urgent desire to pass water, the period varying from one to three hours, and the quantity from one to two or three ounces, both by night and by day. At the moment of passing water, and for some time afterwards, there is an uneasiness, sometimes amounting to severe pain, felt along the whole of the urethra, but particularly just behind the scrotum; and of this uneasiness or pain, a sense of burning or scalding is one of the elements. There is no mechanical impediment to passing the water; and in the earlier stages, after a short time, the whole uneasiness subsides, and the patient remains quite well till the period arrives when he is called upon, as before, to empty the bladder. As the disease advances, all these symptoms become augmented. The unnatural properties of the urine, and of the mucous deposit, increase; the symptoms, and particularly the calls to pass the urine, are more urgent and frequent; the general health and strength, which from the commencement had been disordered and enfeebled, now daily decline, and the patient becomes emaciated, weak, and irritable, and more than ever susceptible of the influence of atmospheric changes. During the whole of this period there is but little uneasiness felt in the region of the kidneys, and what little there may be, is usually referred to weakness. On minute inquiry, patients will sometimes admit the existence of a dull

aching sensation in the loins, and occasional darting pains down the course of the ureter, and even to the testicles, &c.; but these are so trifling compared with the bladder sensations, that they are seldom complained of, unless particularly inquired after. The termination of the complaint is various; most frequently, perhaps, as follows:

"The pulse gradually becomes more weak and feeble, and the stomach, from being weak and disordered, often rejects what is taken, so that the patient is very apt to be sick after eating. At the same time the urine, though not improved in quality, is diminished in quantity, and the calls to pass it are in consequence less frequent. The patient complains of nothing, but he daily becomes more indifferent and drowsy; as the sickness increases, the urine is still further diminished in quantity; at length everything is rejected, the secretion of the urine ceases altogether, and the patient expires, generally in a comatose state. Occasionally the termination is more sudden and unexpected; and in such instances inflammatory symptoms have been generally superinduced from exposure to cold or some other exciting cause. Now and then the patient becomes phthisical—in short, the fatal termination, though always certain, may be various, and depend upon the peculiarities of the patient's constitution, and accidental circumstances.

"Several of the cases described by Mr. Coulson, under the denomination of acute inflammation of the mucous membrane of the bladder, seem to me to be nearly allied to this form of disease. I have reason to believe that the present disease often exists for years

in a chronic form, and confined chiefly to the kidney: that when the degenerating process reaches and attacks the bladder, it sometimes assumes, either spontaneously or from accidental circumstances, a more acute form, and terminates fatally, like those described by Mr. Coulson, with complete destruction of the mucous membrane of the bladder, &c."

These remarks are worthy of consideration, but there is one mark of distinction between the affection which I have described and irritable bladder dependent on organic affection of the kidney so striking, as to have enabled me hitherto to distinguish with tolerable accuracy, the two diseases;—I mean the intense pain which attends inflammation and ulceration of the mucous membrane of the bladder, and soon exhausts the strength of the patient. Now in irritable bladder dependent on organic affection of the kidney, there is sometimes but not always pain in passing the urine; the frequency of making water is the most distressing symptom, and even when pain exists, it is never so severe as to wear the patient out, but may be, and frequently is, endured for years. The intensity of the pain and the rapid exhaustion of the vital powers, mark the distinction between the two classes of cases.

CHAPTER VI.

CHRONIC INFLAMMATION OF THE MUCOUS MEMBRANE OF THE BLADDER.

This is a frequent disease, and in many respects worthy of serious attention. It may arise from a great variety of causes, and presents itself in different degrees of intensity. The disease may succeed acute inflammation of the mucous membrane. In such cases it is often accompanied by ulceration, as I have shown in the preceding chapter, and constitutes a dangerous affection; but generally speaking the inflammation is chronic from the commencement, and is characterised by an abundant discharge of mucus with the urine, whence the term *vesical catarrh*. Chronic inflammation and catarrh of the bladder are not, however, synonymous terms. We may have chronic inflammation without a catarrhal state; and we may have catarrh without chronic inflammation; but in the great majority of cases the inflammation is of a kind which produces an increased secretion of mucus from the vesical lining membrane, and it is of this form that I speak in the present chapter.

Men are more subject to this complaint than women;

and elderly persons more so than the young. It would appear to be uncommon in certain countries; while in others it occurs more frequently, and, according to some authors, occasionally assumes an epidemic character.

The symptoms of the disease may be divided into two classes; those which belong to the inflammatory element, and those connected with the state of the urine, the chief of which is the presence of vesical mucus in superabundant quantity.

The inflammation itself seldom gives rise to any general symptoms, as fever, &c., while the local signs are not very well marked, except in old standing and severe cases, when the inflammation may be supposed to assume a sub-acute character.

In many cases the symptoms are mild, and the patient experiences little inconvenience; there is no pain in the region of the bladder; but the urine is voided more frequently than is natural, and the passage of that fluid is accompanied by a sensation of heat, which extends along the urethra, or shooting pains towards the anus, with a sense of weight in the perinæum.

At other times the disease assumes a serious character and may prove fatal, especially in old and weak persons. The obstinacy and danger of the complaint mainly depend on the causes which have produced the inflammation.

In these severer cases the functions of the urinary apparatus are seriously impeded. The bladder is never emptied in a complete manner. The expulsion of the urine, and particularly of the last few ounces, is more or less painful, according to the violence with which the abdominal muscles and bladder contract. The sense

of heat in the bladder and urethra is converted into scalding; the desire to make water becomes more frequent and is attended by violent straining efforts; and retention often takes place from obstruction of the urethra by clots of inspissated mucus.

These symptoms are relieved by drawing off the urine with the catheter; but they return as the organ becomes filled with fluid.

The patient is very restless and uneasy; there is great thirst; the bowels are irregular, generally very costive or relaxed; there exists pain at the extremity of the penis, round the anus, and in the region of the loins. Great prostration of strength and wasting of flesh are present.

The quantity of mucus secreted varies: sometimes it is small; at other times it is considerable; and cases are recorded, in which several pounds were passed during the twenty-four hours. Small quantities of the mucus thus coming away render the urine muddy, pale, and flaky, and afterwards settle to the bottom of the vessel. The mucus,* however, is sometimes like panada, and being shaken, colours the urine without flakes: at other times it is stringy, flaky, and of a lumpy consistence. It has been found so glutinous, that, on pouring it from one vessel into another, it was drawn out above a foot in length, without rending. Sometimes, it is transparent, white, yellow, green, with streaks of blue, often without smell; sometimes, on the contrary, it is dreadfully fetid. Blood and pus are often passed with the mucus in this disease.

* Soemmering, Uber die Krankeiten der Harnblase.

When the properties of the mucus are but little changed, it diffuses itself throughout the urine for a time, rendering it turbid and of whitish colour; afterwards it subsides to the bottom, and leaves the urine to assume its usual hue. The mucus is commonly thick, viscid, and ropy, and sinks to the bottom of the vessel at once: in which case, the urine is of a dark brown colour, and is either neutral or alkalescent. The urine, however, is usually acid at the commencement, and continues so until the quantity of mucus secreted is great: it then becomes alkaline or neutral, especially if the patients are feeble.

If the mucus comes away in large quantities, and is at the same time glutinous, it is discharged with effort, and often occasions retention of urine. After micturition, the burning sensation in the region of the bladder ceases, but gradually returns as the mucus again collects. If the secretion of mucus be copious, the patient becomes hectic, and at last sinks from exhaustion.

Dr. Prout states that in the advanced stage of the disease the urine undergoes very important changes. The quantity of mucus (in its ropy state at least) is perceptibly diminished; the mucus also becomes opalescent and of a greenish tint, and is not only less tenacious, but can in part be easily diffused through the urine, rendering it glairy, or opake and milky, like pus; in short, the urine becomes muco-purulent. The urine is now generally deep-coloured or serous and alkalescent. When alkalescent it has commonly a strong ammoniacal smell, and effervesces with an acid, and in this case there is almost always an excess of

carbonate of potash or of soda present, derived from the serum of the blood. When these conditions have continued for a greater or less period, the urine becomes scanty, still more high coloured, and occasionally acid; the mucus and even the pus gradually diminish and almost disappear; and after a short period of comparative ease, the patient expires.

The morbid appearances found after death are those of chronic inflammation.

In the commencement, they are usually confined to the neck and posterior part of the bladder; the mucous membrane, usually pale, becomes dotted and streaked with blood, which in part is contained in dilated blood-vessels, and part is extravasated. These spots are generally black, the blood having lost its normal colour. As the disease advances, the discoloration becomes more general and deeper; the membrane is thickened, softened, and flocculent; it tears readily from the muscular coat, and is found abraded, especially in the neighbourhood of some large extravasation. The disease spreads along the mucous lining of the ureters and the tubular structure of the kidneys. The canals become filled with a muco-purulent fluid, and pyelitis may occur. The walls of the bladder become thickened from effusion into its cellular tissue; ulceration often takes place in the mucous membrane, which, as in acute inflammation, may be entirely removed, leaving exposed the hypertrophied muscular fibres. Ulceration, however, is more frequently observed, whenever, from some occasional cause the inflammation assumes an acute character.

The most prominent portions of these muscular columns

are usually of a blue or purplish red colour; while between them, the membrane is pale, swollen, soft, and offering little resistance; occasionally small ulcerations are found. But what is very remarkable, between the hypertrophied columns, pouches or sacs generally co-exist with dilated ureters, both states being produced by the same physical cause.

I have, on more than one occasion, seen the secreting structure of the kidney reduced to a thin layer, covering the widely dilated pelvis and infundibula. The ureter in such case is both dilated and tortuous, and the lining membrane rough and granular, in some instances covered by flakes of lymph.

In the severe form of the disease, all the muscular fibres of the bladder are much enlarged, thickened, and occasionally covered here and there with calcareous deposits. I have in my possession a bladder taken from a man who had long suffered from vesical catarrh presenting this appearance. The fundus of the bladder is usually most diseased, but the whole organ becomes thickened, contracted, and harder than natural, and its mucous membrane purplish and injected, presenting many folds or columns of greater or less thickness, according to their situation and the period of the disease. They are always longest and largest at the fundus. In a few cases of old standing, on the contrary, the mucous surface is pale, and its appearance would never lead us to infer the existence of inflammation in any degree.

It has been said that when vesical mucus is passed in small quantity, the disorder may be mistaken for an involuntary discharge of semen, which accompanies in some persons the escape of the urine and feces.

These two fluids are analogous by their viscid and alkaline properties, and the substances which compose them; but semen differs essentially from mucus by its colour, by the property which it has of liquefying on cooling, by its insolubility in water when thick, and its solubility on the contrary when it is liquid, and especially by the radiating crystals which it produces after slight evaporation. In doubtful cases, recourse may be had to the microscope.

The urine in this disorder may be also distinguished from chylous urine, because the latter, immediately it is passed, presents a whitish appearance, and the sediment, on shaking, mixes with the urine; on the contrary, the urine in vesical catarrh is at first turbid; on standing, the sediment becomes viscid, ropy, and flocculent, or united into one clot.

Catarrh of the bladder is rarely, if ever, an affection of the mucous coat independent of other diseases. In almost every case which falls under the notice of the surgeon, he will, on due examination and inquiry, be enabled to trace it to some co-existing malady, or to the forced retention of urine in the bladder.

The most common exciting causes are stricture, stone, and enlargement of the prostate; after these come exposure to cold, indulgence in ardent spirits, diuretic and irritating remedies, such as cantharides, violent exercise on horseback, and venereal excesses; it also exists in connexion with many organic diseases of the bladder and kidneys; with hæmorrhoids, and other diseases of the rectum. In injuries and diseases of the spine, this state of the bladder usually occurs.

From the preceding observations it will be evident that

in the treatment of vesical catarrh, we must direct our attention not only to the chronic inflammation of the bladder, but to the original disease which has been its exciting cause, and the presence of which keeps it up.

When this disease co-exists with, or is produced by, stricture of the urethra, it is often extremely difficult of treatment. In some cases, it suffices to dilate the stricture to obtain a cure of the catarrh, but in others, the pain and irritation along the urethra are often so great as to render the use of catheters and bougies impracticable: unless the condition of the urethra is improved, no material benefit can be expected from internal remedies. Under these circumstances, free use must at first be made of sedatives; and when the pain and irritation of the urethra have subsided, this canal must be dilated with bougies or the gum-elastic catheter. If the stricture be of long standing and narrow, I commence with armed bougies, introducing them once in three or four days, and in very few cases have I failed, by this means, to dilate the urethra. Cases, however, do occasionally occur, in which dilatation fails to improve the stricture, and recourse must be had to other modes of treatment.

Some persons are apparently more predisposed to this affection than others: such are those of irritable scrofulous temperament with fair skin, and tendency to cutaneous affections, more especially if they have been accustomed to live freely, or are given to venereal excesses, or have suffered from syphilitic affections, or gout. In such individuals, exposure to cold is the most frequent exciting cause of this affection, and those who actually labour under it, generally suffer much more

severely in cold weather. Gouty persons are very subject to this affection.

Cases of milder character have been observed to terminate in a short time, or to assume an intermittent form, especially when associated with hæmorrhoids, or certain petechial affections; but the duration of the complaint is uncertain. Old persons mostly retain it as long as they live. The catheter, even if there be no retention, must occasionally be employed; but in severe cases, retention generally exists, and the water should be drawn off twice or oftener in twenty-four hours.

Chronic inflammation of the bladder connected with disease of the prostate, or with lesions seated about the neck of the organ, is always more severe and difficult of cure than when dependent on stricture of the urethra. The difference between the exciting causes readily accounts for this difference in the affection which they produce. It is slow and insidious in its progress, and is liable to vary much in intensity at different periods of the disease. A careful examination of the bladder will alone enable the surgeon to ascertain the particular nature of the co-existing lesion, and determine the method of treatment required for it.

The presence of a foreign body in the bladder is a frequent exciting cause of catarrh; and its connection with vesical calculus is now well understood. In cases of this kind we possess in the sound a certain means of diagnosis, and the treatment must be guided by the principles which I have laid down under the head of urinary calculi.

The same remark will apply to the various other exciting causes of this affection; and to avoid repe-

titions, I must refer to what has been said in different parts of this work concerning the treatment of enlarged prostate, atony of the bladder, organic disease of that organ, &c.

If any constitutional tendency to gout exist, colchicum should be administered. The form in which I am in the habit of giving it is the acetous extract, in the dose of one or two grains at bed-time. In these cases, small doses of copaiba, or of the essential oil of cubebs, with hyoscyamus, will often do great good, and they may either be added to the infusion of buchu, or decoction of pareira brava, or be given alone.

But it will not be sufficient to get rid of any constitutional tendency, or confine our treatment to the disease of which the catarrh appears to be an effect. The internal surface of the bladder is in a state of chronic inflammation, and to this, likewise, the attention of the practitioner must be directed; while endeavouring to remove or palliate the exciting causes, he must also employ measures calculated to diminish in a direct manner, the inflamed state of the mucous membrane of the bladder.

To attain this object, antiphlogistic treatment must be employed, cautiously, and with due attention to the circumstances of each case. Unless the disease has, from some accidental cause, assumed more or less of an acute character, I have never found it expedient to employ general bloodletting; nor can I recommend the local abstraction of blood in any considerable quantity, except at an early period of the disease, in healthy persons, and when the severity of the symptoms indicates that the inflammation is one of a sub-acute character.

Of the remedies destined to act either directly or indirectly on the bladder, those from which the greatest benefit has been derived, are balsams, opiates, uva ursi, the pareira brava, and medicated or simple injections.

In many cases the catarrhal state of the bladder seems to be kept up, rather by irritation than actual inflammation, and here opiates are obviously indicated; they may be administered by the mouth, or, better still, in the form of enema, care being taken to obviate, by mild laxatives, any constipation which they may have a tendency to produce.

Sir Astley Cooper, and Baron Dupuytren, placed great confidence in the balsams as a remedy for catarrh of the bladder. Sir A. Cooper says,—"The best remedy that can possibly be taken is the balsam of copaiba; no medicine so completely robs the urine of mucus as this. Eight or ten drops three times a day will usually be found quite sufficient; it may be given in conjunction with sweet spirits of nitre and camphor mixture, or in ʒij mucilag. gum. acaciæ, et ʒx aq. font." Dupuytren employed Venice turpentine in the form of pills, instead of copaiba.

This latter remedy may be given with advantage in combination with small doses of zinc, Chio turpentine, or sulphate of iron; but whatever other remedies may be used, the surgeon must not omit the use of morphium or opium once or oftener in the twenty-four hours. Cubebs and copaiba must, however, be administered with care; for, after the long-continued use of these medicines, chronic inflammation of the bladder sometimes comes on. I am frequently in the habit of

giving the tinctura benzoini composita (in the dose of a teaspoonful) three times a day, with considerable relief to the patient. When the urine is alkaline, and contains a good deal of mucus with the phosphates, the alchimella arvensis may be administered with advantage. An ounce of the dried plant is to be infused in a pint of boiling water for three or four hours; and two ounces of the infusion are to be taken three times a day.

The medicines found most serviceable where there is much secretion of mucus, are the decoction of uva ursi, with the muriated tincture of iron, and small doses of powdered galls and nitre. If there be much pain and irritability of the bladder, the decoction of pareira brava is an excellent medicine; and it may be combined with nitric or nitro-muriatic acid, or dilute phosphoric acid, to lessen the secretion of mucus. If there be much pain and restlessness, morphium or opium ought on no account to be omitted. Barthez mentions a case in which fifteen pounds of mucus were passed in thirty-six hours, and which was cured solely by the exhibition of large doses of opium internally, and in the form of clyster.

The bladder, when suffering under chronic inflammation, is susceptible of being acted on directly by remedies introduced through the urethra. The attention of surgeons has been much directed to the influence of injections.

Nitric acid injections are of great use in cases where the effects of the disease are local; the general health not being much impaired, and the patient feeling comparatively well when the scalding and pain after passing urine have subsided. In cases also where the internal

administration of acids appears to have no effect on the secretion of mucus, the injection of acid is of great service. The following case strikingly illustrates the beneficial effects of this method.

Mr. F., æt. 67, slightly rheumatic, consulted me, April 7th, on account of an affection of the bladder. He complained of frequent desire to make water, with severe pain and scalding along the urethra, just before and during its passage, and of uneasiness or sense of weight above the pubes. He had occasional retention, and was frequently compelled to pass a catheter to draw off the urine. The disease was brought on by retaining the urine on one occasion, after the desire to void it had come on. There was no enlargement of the prostate, nor any stricture. The urine was alkaline, and contained a considerable quantity of mucus, which was of a dirty white colour, and sank to the bottom of the vessel; it was stringy, and on being shaken with the urine did not mix: it was free from blood. The urine, on being passed, had a slight ammoniacal smell; but this became very strong on standing twenty-four hours. Its specific gravity was 1·015. His general health was not impaired; and he felt pretty well when the burning pain, which attended the passing of urine had subsided. I tried the decoction of pareira brava, with the dilute nitric acid and sedatives, without any relief whatever.

May 8th.—The quantity of mucus with the phosphatic deposits increasing, I recommended the injection of the bladder, first throwing in, by means of a gum-elastic syringe and catheter, four ounces of decoction of poppy; and, on withdrawing this, four ounces of water,

containing two minims of strong nitric acid. I kept this in for two or three minutes, and withdrew it. He took half a grain of morphia immediately after the injection. The symptoms were a little, but not materially improved by the injection.

May 10th.—I injected ten ounces of distilled water with one minim of the strong nitric acid to the ounce of water (five ounces at each injection), and caused each quantity to be retained for two or three minutes, until he complained of slight pain or uneasiness.

May 12th.—The symptoms and condition of the urine were slightly improved. I injected ten ounces of distilled water, with two minims of the strong nitric acid to each ounce of water, in the same manner as before. This injection was followed by considerable pain, which continued several hours; but on the following day the urine was much changed in appearance, contained little or no mucus, and had lost its dark brown colour. The irritability of the bladder was considerably lessened. I injected the bladder twice after this, but with a smaller proportion of acid; the urine, which had been alkaline, became acid, and the patient lost all his bad symptoms.

The tenacious mucus secreted in this state of the bladder deposits phosphate of lime; and when phosphate of lime from this source coexists, as it often does, with the triple phosphate in the urine, a compound salt is formed. In such cases, a weak solution of nitric acid (beginning with a drop, and gradually increasing it to two drops of concentrated nitric acid, to two ounces of distilled water), if injected into the bladder, acts as a salutary astringent. I use the same apparatus for acid

injections as for injecting the bladder in lithotrity, since the minute quantity of the acid is not likely to act on the nickel-silver of which these instruments are composed. Sir Benjamin Brodie was the first to advise the use of nitric acid injections in this complaint.

M. Civiale, and many other surgeons, prefer simple to medicated injections, and their well-established influence over irritability of the bladder naturally leads to the inference that they may be found useful in a complaint where to irritation is added a considerable change in the qualities of the urine. According to M. Civiale, the objects we should endeavour to attain by injection of the bladder are to remove any deposits or offending matter thrown down by the urine—to modify the sensibility of the organ, and restore its natural contractile power, which has been impaired by the chronic inflammation.

For the success of this practice it is essential that the introduction of an instrument be not productive of much irritation; for if it be, the pain and irritation caused by the catheter will exceed any benefit which the injections can produce. Generally speaking, it will be prudent to commence with tepid water, gradually diminishing the temperature, which must be cold whenever the bladder is sluggish. Having drawn off the urine with a gum-elastic catheter, we should inject the tepid water in a gradual manner, stopping it as soon as the patient experiences a desire to empty his bladder. In no case should the quantity injected be sufficient to produce any pain or sense of distension. The syringe is now withdrawn, and the fluid allowed to escape gradually from the catheter. This operation may be

repeated once a day, or oftener, if the last portions of urine continue charged with mucus. In a few days the patient becomes accustomed to the injections; he makes water more freely, and his urine is evidently improved in quality. It is now time to modify in a slight degree the mode of proceeding.

Instead of a single injection, two are to be thrown in—one immediately after the other; and about one fourth of the second injection should be allowed to remain in the bladder. The effect of this simple treatment is soon felt, and it must be continued until the state of the urine indicates a permanent improvement in the condition of the bladder.

When the chronic inflammation does not yield to simple injections, or when it appears to be connected with irritation about the neck of the bladder, some practitioners have had recourse to the injection of certain remedies known to influence the sensibility of mucous surfaces. Nitrate of silver is the one generally preferred. M. Lallemand has employed this substance in solution, and also in substance, with the object of effecting temporary cauterization.

The following is his mode of employing this remedy:—He uses a large catheter (of pure silver, as the caustic acts upon it if there is any alloy) open at both ends, having two sorts of stilet, according to the part intended to be cauterized; at the extremity of each stilet is a small excavation, containing the caustic, which is first pulverized, and then placed in the excavation over a spirit-lamp, which fuses and moulds it to the cavity.

When the instrument is prepared, an ordinary ca-

theter must be introduced into the bladder in order to empty it completely. This precaution is strictly necessary, for the urine would dissolve the caustic, and prevent it from directly affecting the mucous membrane. When the catheter has been withdrawn, the instrument with the caustic is to be introduced, and the moment it has entered the bladder, the surgeon pushes the stilet, and rapidly turns the porte-caustique from side to side two or three times, then pulls the stilet into the instrument, and withdraws it; the object should be to touch the surface in as many points as possible. While the instrument is within the bladder, the latter contracts and grasps it, while the kidneys secrete a small quantity of urine, as the lachrymal gland secretes tears when the conjunctiva is cauterized; but this small quantity of liquid, far from being hurtful, is on the contrary favorable, as it acts as a vehicle to the part the caustic does not touch, and conveys it equally over the surface of the membrane. Patients feel, at that moment, a sharp pain at the neck of the bladder and in the rectum, described by them as if they were pinched, but much more supportable than the continued dull pain of chronic catarrh; there is now an irresistible desire to pass water, but the bladder being nearly empty very little is voided, and this causes a burning along the urethra, often accompanied by some drops of blood. This desire is frequently renewed, causing violent but useless efforts. These gradually decrease, and on the second and third day, there is no longer any pain on making water, and a few small grey eschars, like burned paper, come away with the urine. This occurs in a large number of patients, but in some more susceptible, the process does

not proceed so simply, particularly if the porte-caustique has been applied too long. In this case retention of urine follows, which lasts several hours; even here we must not be in too great a hurry to use the catheter, as a warm bath, a few narcotic lavements, emollient drinks, some tartrate of soda with infus. sennæ, and sometimes a few leeches, will cause the spasms to yield. If these means do not succeed, recourse must be had to the catheter. In a majority of cases one cauterization is sufficient to effect a cure; when it happens otherwise, a second and even a third application may be necessary, but Lallemand states that he never saw a case requiring a fourth.

Dr. Devergie has recorded eight cases of chronic catarrh, some of long standing, which were cured by injecting balsam of copaiba into the bladder. Some of these cases had been developed gradually, and maintained throughout their chronic character. A moderate quantity of an emollient fluid must first be injected, to ascertain the capacity of the bladder, but not in sufficient quantity to irritate it. General measures must be resorted to, to calm the inflammatory action and local pain. Narcotics must next be added to the emollient injections; and these may be repeated three or four times a day. When the irritation of the bladder and neighbouring parts is allayed, the copaiba should be injected. A dose of uniform strength is not suited to every case. A drachm of balsam of copaiba to an ounce of barley-water is sufficiently strong for the first injection; but the quantity of balsam must be regulated according to its effects. The combination of narcotics with copaiba renders the latter less exciting.

The balsamic injections may be allowed to remain in the bladder for a period from ten to twenty minutes. The quantity of copaiba is to be gradually augmented; and it should not be injected more frequently than once daily, nor intermitted more than two days. The injection is to be continued until the muco-purulent secretion has quite ceased.

In the severer forms of vesical catarrh, where there is great depression of the vital powers, the patient should be sustained with light nourishment, and small quantities of wine given from time to time. In the milder form, patients may be allowed to take animal food; but beer, wine, and spirits, must be strictly prohibited. Patients must also be cautioned against irregularities of every kind, and must be told the consequences of neglecting the advice given them. From want of care on the patient's part, the mild has often assumed the severe form, and an attack of acute inflammation has come on and destroyed life.

I attended an elderly person, who, for some time previous had been subject to occasional difficulty in passing urine, and to the discharge of mucus, which latterly had much increased. When I saw him, there was frequent desire to make water, attended with great uneasiness and pain in the lower part of the abdomen, sense of burning in the urethra, inability to micturate, cramps in the legs, thirst, and slight shivering. On drawing off the water, these symptoms subsided for a time; but they invariably returned on the filling of the bladder. The urine was acid, of a dark brown colour, and contained a great quantity of mucus, more of an amber than any other colour. This always subsided to

the bottom of the vessel, was very tenacious on being everted, and could be drawn into long strings. Sometimes this mucus would come out in clots, and it was occasionally streaked with blood, and offensive to the smell. On exposing some of it to the action of cold for a few hours, it became quite dense. Morphia, the decoction of uva ursi, with the ammoniated tincture of iron, the decoction of pareira brava, lavements, and the regular introduction of the catheter, were employed, but without avail; the patient's strength gradually declined; and he sank at the end of six weeks. There was no post-mortem examination.

The following interesting case occurred in the practice of Dr. Elliotson. For a great number of years the individual had laboured under cystorrhœa, as it is sometimes called, or a discharge of mucus from the bladder. A great quantity of mucus was constantly deposited in the vessel which he used; and that it was true mucus was evident, from its capability of being drawn out into long threads. This continued for a number of years, and various remedies were employed; but they were all rendered useless by his taking an excessive degree of exercise. Any remedy, however, that was at all irritating, did him a great deal of harm; mild means only were suited to him. The consequence of not taking care of himself, and of taking considerable exercise, was, that what at first was a mere increased secretion from the bladder, became at last an organic disease of that viscus, slow inflammation, hypertrophy, and finally, pretty active inflammation.

The following were the morbid appearances found on dissection:—The bladder was amazingly thickened: its

substance was in a high state of hypertrophy, the muscular fibres being considerably increased in size. There was very considerable hypertrophy of the muscular coat, mucous membrane, &c., at the part corresponding with the trigonum; so that a large transverse fold was formed by it. This person had from 300 to 400 small stones in the gall-bladder, but he never suffered any inconvenience from them, and their presence was unexpected. He had no stone, no stricture, no difficulty in passing water, but an excessive discharge from the interior of the bladder, for many years. From its rugous state, the interior of the bladder might be compared to the interior of the stomach. The symptoms preceding death were agonising pain, a constant desire to make water, a discharge of blood as well as of mucus, which at last was rather pus than mucus. From excessive secretion, there came on chronic inflammation of the substance of the bladder; and finally, that chronic inflammation became acute, and destroyed the patient.

CHAPTER VII.

INFLAMMATION OF THE WALLS OF THE BLADDER.

Inflammation of the bladder almost always commences in the mucous lining of the organ, and when very severe often extends to the deeper seated tissues. Some authors suppose that the muscular structure alone may be the seat of inflammation ; but analogy and experience lead me to concur fully with Dr. Prout, who says—"I am quite unaquainted with, and indeed doubt, the existence of the commencement, and particularly the limitation of ordinary inflammation to the muscular structure of this organ." Inflammation may confine itself to the mucous tunic, or it may limit its action to the peritoneal covering of the bladder ; but with respect to the muscular coat of this viscus, I am of opinion that it is seldom, perhaps never, exclusively the seat of inflammation.

In some cases, however, abscesses form between the serous and muscular coverings. Morbid anatomy proves to us that inflammation may arise in this situation, that the walls of the organ become thickened, and pus is secreted in one or more cysts, which in course of time burst through the mucous membrane or open in various

directions. The muscular structure in these spots is wasted and in great part destroyed, a few stray fibres only being found about the walls of the abscess. Such cases have been regarded as examples of inflammation of the muscular coat; but it would be more correct to regard the areolar tissue, and not the muscular fibres, as the seat of inflammation; in short, to class the affection as we should class an abscess occurring in any other situation. From this central structure the inflammation has a great tendency to spread in every direction; and hence it is that we never observe it to be much inflamed, without finding the other tissues of the bladder more or less involved in the morbid action. This disease more frequently attacks adults than the young or old, and strong than delicate persons. It is also more common in males than females, whilst the contrary is the case in acute inflammation of the mucous membrane.

The causes of inflammation occupying the deep cellular tissue of the bladder, are nearly the same as those which excite acute inflammation of the mucous membrane. It may be caused by retention of urine from stricture, enlarged prostate, &c.; calculus or the use of caustics may give rise to it; and in some cases the disease can evidently be traced to external injury, or the violent use of instruments. It is sometimes caused by exposure to cold, and indulgence in spirituous liquors; but more frequently it occurs on a sudden suppression of the discharge in gonorrhœa, when metastasis takes place to the bladder. The immoderate use of cantharides internally, and, in excitable persons, even the external application of that medicine, will produce this

disease. After an irregular or suppressed attack of gout, this affection comes on, and frequently assumes a serious and formidable character.

The symptoms are obscure, and are seldom sufficiently well marked to lead to a positive diagnosis, unless the existence of abscess can be ascertained by manual exploration.

The patient first complains of a dull aching pain in the region of the bladder, which soon becomes more violent, and extends to the neighbouring organs. This pain is increased by pressure, and is attended by desire to pass urine, without the power to accomplish it. The desire comes on in paroxysms, attended with pain; the urine is at first evacuated in small quantities; and the attempt to pass it causes great pain. In some cases, however, where the inflammation is limited to small portions of the bladder, the patient has never complained of any painful sensations. The small quantity of urine which escapes is of a dark colour, sometimes not unlike coffee in appearance; at other times it is of a deep red, and even blood colour; and at last complete retention occurs. There is a sense of fulness in the lower part of the abdomen, and pains in the lumbar region, in the groin, and down the thighs; but there is not the burning sensation along the urethra and in the perinæum which exists in inflammation of the mucous membrane.

The disease is ushered in by rigors, which are soon succeeded by great constitutional disturbance. The pulse is full and hard, the thirst great, and the skin hot, with general uneasiness and sickness. If the inflammation increase, pains are felt in the intestines, particularly in the rectum, combined with tenesmus;

delirium comes on; the pulse rapidly sinks; and the patient soon dies.

If the inflammation should be seated in the neck of the bladder, as is frequently the case, the urine is retained by the tumefaction ensuing from the inflammatory action; the bladder soon becomes distended, and projects above the pubes. There is a sense of weight in the perinæum; there are often painful erections of the penis; and examination by the rectum gives great pain.

The anatomical structure of this part readily accounts for these symptoms. The triangular space is at once very vascular and highly sensitive;* its nerves, arising from the third and fourth sacral pairs, as well as from the great sympathetic, descend on each side through the inferior mesenteric and the hypogastric plexus, and communicate more particularly upon this space. We have, therefore, only to recollect the relative connexions and ramifications of these different nerves to be able to explain, not merely the strong and constant desire to evacuate the bladder that prevails when this part of the bladder is irritated or inflamed, but also the remote symptoms by which this inflammation is liable to be accompanied.

If the inflammation exists somewhat higher up in the bladder, where the ureters enter, the orifices of the

* With regard to the urethral opening of the bladder, Mr. Guthrie observes, "that fibres have been described surrounding this part, though no anatomist has demonstrated them so as to warrant their being called a sphincter muscle; that this part may be both muscular and elastic, but the older anatomists supposed the power which prevented the flow of urine, to reside in other muscles surrounding the membranous part of the urethra."

latter become contracted, and the bladder being closed against the influx of the urine, the ureters become enormously distended. The orifice of the ureters is surrounded by a dense elastic substance, which lies between the muscular and the mucous coats of the bladder. Beginning at the base of the triangular space, this substance inclines inwards as it advances towards the neck, forming in a great measure the orifice, and appearing to be continued through the urethral passage as its elastic membrane. This elastic triangular substance yields, in some measure, to the pressure of the urine, when impelled by the detrusor, and returns to its original situation when the pressure is removed. If the inflammation be situated more in the upper part of the bladder, there is danger of its extension to the peritoneum, and the pain is greater on pressure; but the desire to pass urine is not so frequent, nor the difficulty so great.

The progress of the disease keeps pace with the severity of the symptoms. Very severe cases, occurring, for instance, after suppressed gout, sometimes terminate fatally within a short time from the commencement of the attack; but, in ordinary cases, if active measures be employed, the pain, after two or three days, begins to subside, and the water flows with greater facility, is less acid, and of lighter colour. The febrile symptoms, and, at the same time, the local uneasiness, lessen.

This kind of inflammation sometimes terminates in the formation of abscess between the coats of the bladder, the symptoms of which present a formidable character, depending upon the size and situation of the abscess. The abscess may open into the cavity of the

bladder, and in this case, pus is evacuated with the urine, and the patient experiences great relief; it may open into the cavity of the abdomen, or the matter may extend into the cellular tissue of the pelvis, and make its way either through the intestines, probably the rectum, to the perinæum, or even to the groin, and in these cases the result is most frequently fatal. Mr. Wilson mentions an interesting case in which extensive suppuration had taken place in the coats of the bladder, from the prostate even to the fundus, the matter being lodged everywhere between the tunics; while near the fundus several ulcerations had penetrated the internal membrane, by which the matter had passed into the cavity of the bladder.

After the formation of an abscess the urgent symptoms subside; but dull pain in the region of the bladder, occasional rigors with febrile excitement, and uneasiness in passing urine and feces still continue.

This disease may easily be mistaken for acute inflammation of the prostate. The uneasiness and pain in the region of the bladder and the perinæum, the occasional but strong desire to pass urine, every effort being attended with great pain and retention, are symptoms common to both diseases. In inflammation of the prostate, however, there is more fulness with tenderness on pressure in the perinæum, and on examination per rectum, the prostate is found exceedingly sensitive, painful, and swollen.

In recent cases, the morbid appearances in acute inflammation of the walls of the bladder are, great vascularity, the deep-seated tissues being throughout injected with blood, and of dark red colour. Sometimes

the walls are found even to be gangrenous; instances are recorded where they had given way, and urine had escaped into the pelvis. The mucous membrane is also found of a dark red colour. In other cases the muscular tissue is thickened, and the bladder itself contracted. Pus is often infiltrated through the tunics, or else circumscribed in the form of abscess.

The following case is one of the best illustrations of this form of inflammation which has come under my notice. Richard Serigiter, æt. sixty-eight, watchmaker, after a slight attack of gout, was seized with rigors, which were succeeded by fever and great constitutional irritation. The pulse was extremely quick; the skin was hot and dry; and there were great thirst and sickness. He had a strong desire, coming on in paroxysms, to void urine; but he could pass only a few drops at a time. There was pain in the region of the bladder and loins. Colchicum and saline aperients, were administered; leeches and warm fomentations were applied to the region of the bladder; and the warm bath was tried. The bladder being distended, a catheter was introduced; and between two and three pints of very dark urine were drawn off. None of these measures gave relief: the constitutional disturbance increased, delirium came on, and the man died within forty-eight hours from the commencement of the attack. On the day after his decease, I examined the body, and found the bladder in a state of intense inflammation: in its structure there was no organic change; but the tunics, particularly the muscular, were of very deep red colour. I have the preparation of this case in my

possession; and although it has been in spirit several years, it still retains its redness.

The symptoms of this disease are so severe, and its progress so rapid, that prompt and decisive measures must be adopted. If the patient be strong and robust, general bloodletting must be first employed; or if he be delicate, and of spare habit, local bleeding, by leeches to the pubes, or cupping in the perinæum, may be substituted; or both may be put in requisition as auxiliaries to general bloodletting.

Hot fomentations should be constantly applied to the pubes; and, after the bleeding, the patient should be placed in a hot bath. As already observed, there is in these cases retention; and the urine must, from time to time, be drawn off by the catheter. Internally, our main reliance must be placed on the use of calomel and opium, which must be given every three or four hours; this medicine affords the most speedy relief. As tenesmus often exists, the proportion of opium should be large; and sedative injections should, at the same time, be administered. After the urgency of the symptoms has subsided, saline aperients, combined with the vin. semin. colch., will be found beneficial, especially if the attack has occurred in a gouty subject. The diet must consist entirely of lukewarm mucilaginous drinks.

If these means be employed early, the patient may experience a diminution of pain; urine is passed in greater quantities and with less suffering; the constitutional symptoms improve; and the patient falls into sound and refreshing sleep. If, on the contrary, these measures be delayed, the symptoms before described become aggravated, and death ensues.

CHAPTER VIII.

HYPERTROPHY OF THE BLADDER.—SACCULATED AND COLUMNAR BLADDER.

Any long-continued irritation of the bladder, acting directly on its mucous surface, as that from stone, or indirectly, as the irritation provoked by retention of urine, by stricture, &c., may produce certain lesions, a knowledge of which is of great importance to the surgeon.

In these cases the muscular fibres of the bladder become hypertrophied, and cross each other in various directions giving to the interior of the organ that peculiar appearance which has been called *vessie à colonnes*, or columnar bladder. This hypertrophied state extends to the whole muscular tissue of the organ, which is generally found more or less contracted on itself, and therefore thickened.

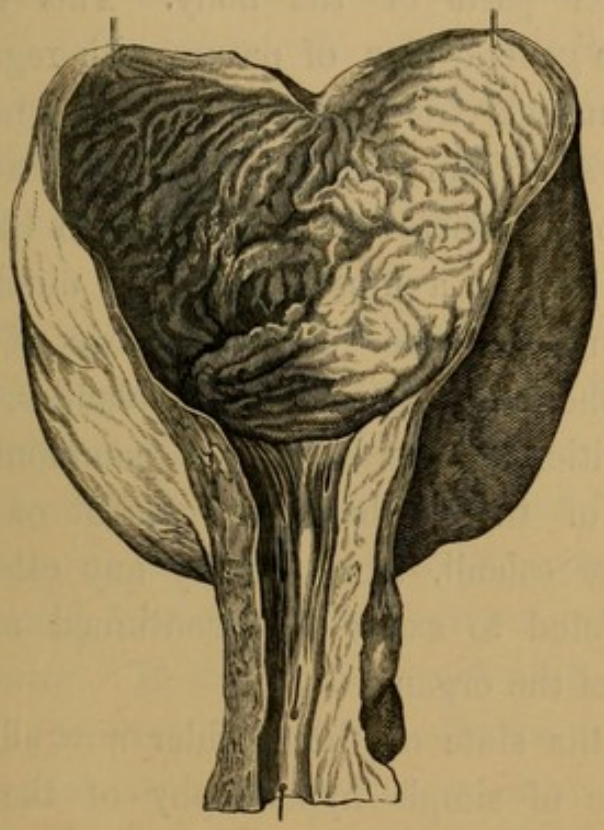
In hypertrophy there is uneasiness about the region of the bladder, frequent desire to make water both night and day, but especially by night, and the urine does not flow so readily as usual; there is also occasional prolapsus of the rectum; and these symptoms are increased by exercise. In this state the coats of the

bladder become thick and hard, so that they no longer admit of their former degree of extension. It must be borne in mind that the neck of the bladder and the urethra have around them the muscles termed the compressor prostatæ, the levator urethræ, and the ejaculator seminis, besides the columns of the levator ani. All these muscles must relax before a drop of urine can pass; and any irregular action in them directly obstructs the passage, whilst it tends to develop hypertrophy of the bladder by rendering its contractions more violent and long-continued. The contraction, indeed, of one set of these fibres, and the relaxation of the other, belong to the same act, like the condition of opposing muscles in the motions of the limbs; so that if the bladder be not in a state to execute its functions, these muscles are not in a condition to relax. "The elasticity of the neck of the bladder," says Mr. Guthrie,* "is impaired; it will not dilate with the ordinary action of the detrusor muscle; and this action is therefore augmented. A sensibly increased delay is experienced before the water begins to flow, the patient is obliged to expel it; and he becomes conscious of the augmented effort made by the bladder. The desire in which this originates soon amounts to uneasiness, and rapidly afterwards to pain—relieved indeed on evacuating a little water, but too soon to return; for now the bladder is never completely emptied, and the urine which remains is a source of great irritation, although the quantity be really inconsiderable."

On dissection, the bladder will be found more or less

* On Diseases of the Bladder, Lect. XV., p. 256.

thickened; its inner surface presenting a considerable number of rugæ, caused by projection of the enlarged fasciculi beneath. Dr. Baillie has given the representation of a bladder nearly an inch in thickness; the prostate gland being at the same time enlarged. One of the most ordinary changes in the bladder, from its natural structure, says that physician, is the great thickening of its muscular coat. This arises from



THIS FIGURE REPRESENTS THE BLADDER WITH ITS MUSCULAR FIBRES HYPERTROPHIED.

an additional quantity of muscle being formed in consequence of extraordinary efforts being necessary in the bladder. These efforts take place when there is any considerable difficulty in making water, as happens when the prostate is a good deal enlarged,

when there is a stone in the bladder, or when there are strictures in the urethra. It is usual, therefore, to find this thickening of the muscular coat, when there is any of these diseases.

When the bladder is thickened, the fasciculi of which its muscular coat is composed become much larger; but they never, or at least very seldom, acquire the full red colour which muscles of the same size have in other parts of the body. This is a deviation from the general plan of nature with regard to the increase of muscle from exercise. When muscles are enlarged in size from exercise, they also become of a deep red colour. There is no instance in the body, as far as I recollect, of a muscle being so much enlarged beyond its natural size in consequence of increased exertion, as the muscular coat of the bladder.

This condition of the bladder is commonly induced by stricture of the urethra, enlargement of the prostate, prostatic calculi, stone, or by any other circumstance calculated to excite long-continued and violent contractions of the organ.

Although the state of the bladder now alluded to is generally one of simple hypertrophy of the muscular tissue, yet I am convinced, from several post-mortem examinations which I have made, that it is more frequently accompanied than many writers are willing to admit, by chronic inflammation of the intermuscular cellular tissue. This is shown to be the case by the manner in which the muscular fibres are sometimes matted together, and by the uniform way in which the thickening of the walls extends over the whole bladder.

When this disease is produced by stricture, or any local

cause, it is clear that the primary affection should especially engage our attention. In gouty, rheumatic, or plethoric persons, colchicum given at night, in the dose of one or two grains of the acetous extract, will be found of great service; and as, in these cases, the urine is acid, and often scanty, the alkalies should also be given. I usually advise them to be taken after meals; and I employ them in a combination of bicarbonate of potash, sesquicarbonate of soda, and nitrate of potash. In addition to these medicines, great benefit will be derived from pareira brava, a very useful medicine, which may be given in ten grain doses of the extract, three times a day, or in the form of decoction.

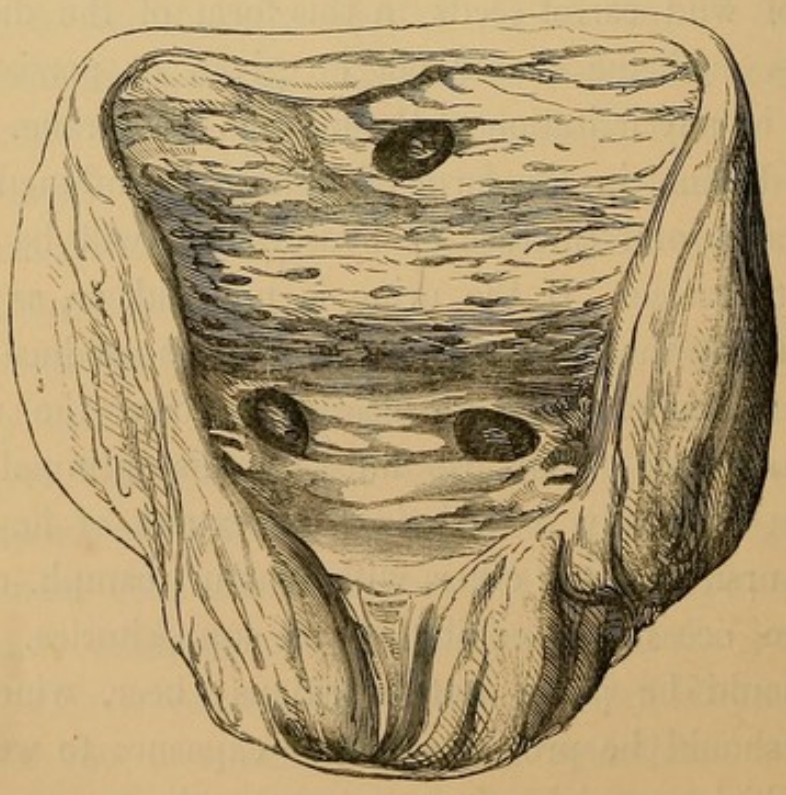
I have often, with great advantage, tried the infusion of wild carrot-seeds in this form of the disease; but this medicine should not be given or persisted in if there be any irritation of the mucous membrane.

The diosma, in the form of infusion, combined with the alkalies and tincture of hyoscyamus, will be found of great service. If the urine is not acid, or, as is not unfrequently the case, should the alkalies produce headache and restlessness, or uneasiness about the region of the stomach, their use must be discontinued, and recourse had only to sedatives, as extract of hop, and of uva ursi, or nitric ether, with tinctur. camph. comp., and the occasional exhibition of suppositories. The diet should be plain, but nutritious; beer, wine, and spirits, should be prohibited; and exposure to wet and cold, which invariably aggravates the disease, carefully avoided.

As in these cases the bladder is seldom completely

emptied by its own efforts, a catheter should be introduced from time to time, and the patient be instructed to do this for himself. Unless this direction be strictly attended to, the patient will become worse, and serious consequences ensue.

An hypertrophied condition of the bladder is often accompanied by another state, depending on the same causes, and denominated "sacculated bladder." Whenever the bladder is excited to violent contraction, while there exists at the same time some obstruction to the flow of urine, the mucous membrane has a tendency to be forced between the hypertrophied fibres of the muscular tissue which leave spaces between them; and gradually yielding to the pressure, form cysts or sacs.



THIS FIGURE REPRESENTS A BLADDER WITH THREE CYSTS.

The following case, related by Mr. Solly, at the Patho-

logical Society, illustrates this condition of the bladder. A man, æt. 51, was admitted into St. Thomas's Hospital, April 22d, 1851, with retention of urine. He had suffered from stricture for three years. The stricture gradually became worse, and at last ended in complete retention, for which he had been admitted, under Mr. South, in January. He stated that he had never had a catheter passed before this, but that he had several times experienced a discharge of blood with urine. On this occasion all attempts to introduce a catheter into the cavity of the bladder failed; the instrument, though passing far enough to reach that organ, not moving freely, and no urine coming away through it. The retention, however, was relieved, and the urine, at first thick and alkaline, was rendered clear by the administration of dilute sulphuric acid. He went out, passing his urine in a very good stream, the latter end of February. Soon, however, the stream lessened, and for ten days previous to admission the urine only dribbled away. Several ineffectual attempts had been made to introduce the catheter, which caused profuse hæmorrhage.

On admission, a large-sized catheter was introduced sufficiently far to reach the bladder, but no urine followed. On examination per rectum, the prostate was found of natural size. Next morning, Mr. Solly succeeded in introducing a full-sized catheter, and drew off a quantity of thick, very offensive urine, apparently containing a good deal of pus. There remained an irregular lobulated tumour in the left hypogastrium, apparently solid, painful, and tender on pressure.

On the 27th, he complained of severe pain in the

tumour; he had passed a considerable quantity of urine, so that it was thought needless to introduce a catheter. The countenance became anxious, the tongue furred, and the pulse quick and weak. The urine was dark-coloured, very thick, extremely offensive, and showed, under the microscope, many crystals of phosphate of lime, a few blood-corpuscles, and a quantity of granular matter aggregated in irregular masses. Next day he became comatose, and died the following morning.

Upon examination after death, a stricture was found about the membranous portion of the urethra; there were also several false passages. There was no disease or enlargement of the prostate. The muscular coat of the bladder was very much thickened, and in several places large herniæ of the mucous coat had escaped between its fibres, and formed capacious cysts, communicating by narrow orifices with the cavity of the bladder, which were full of urine. It was these cysts which had formed the tumour in the left hypogastrium, noticed during life. Both ureters were very much distended throughout, and at intervals swelled into large cysts. The mucous coat of the bladder was very much thickened, inflamed, and ulcerated. Both kidneys were larger than usual and pale.

A sacculated condition of the bladder very frequently exists in old and severe cases of stricture; and I have often met with it as an accompaniment of stone. There is great variety in the number, size, and form of the sacs. In several cases I have discovered only a single cyst of moderate size; but generally we find two or three together. M. Civiale saw a bladder almost entirely covered with small cysts, so as to resemble a bunch

of grapes. Platner saw one having thirty-nine sacs, each containing a calculus. The cysts are sometimes small, often large, and as M. Civiale remarks, their size is almost always in inverse ratio to their number. Heister, however, met with a bladder which contained numerous small and three large cysts—one on the right side, another on the left, and a third at the summit. When the sac is small, the orifice through which it communicates with the bladder is also small; as the sac enlarges under the influence of pressure, the orifice becomes proportionately wide; though in some cases the entrance into a large sac has been found comparatively narrow. At an early stage of their formation, the walls of these cysts are entirely composed of the mucous membrane, which has been driven out between the muscular fibres, carrying the peritoneum before it. This disposition of the cyst should not be lost sight of in reference to the operative proceedings connected with them. In some old cases, however, a few thin muscular fibres may often be traced over those parts of the sac in the vicinity of its orifice. The cysts generally contain urine, which is often fetid or mixed with pus; M. Andral mentions tubercular deposit, but this must be extremely rare. Phosphatic deposits and calculi, on the other hand, have often been discovered in them.

Every part of the bladder is liable to the formation of these sacs, but they most frequently exist at the fundus or posterior surface. On examining the preparations preserved in our anatomical museums, we rarely find cysts in the neck and anterior part of the bladder.

The presence of these sacs often gives rise to serious

symptoms. The urine in them cannot be expelled, owing to the absence of a muscular covering, and their orifices may be contracted by the formation of a band or valve. The urine may deposit gravel, become fetid, and, according to Chopart, give rise to abscess between the walls of the organ. Calculi may drop into or be formed in them. If the sac be large and distended with urine, it may excite many of the symptoms of retention; and the lining membrane may undergo a process of softening and disorganization attended with general disturbance of the constitution. I have observed that the sac often contains pus, while no trace of inflammation can be found in any other portion of the bladder.

The diagnosis of this condition is always attended with difficulty. The distended sac may sometimes be felt through the abdominal parietes, especially in thin subjects; and after the bladder has been emptied by the catheter, pressure over the pubes may cause the evacuation of an additional quantity of urine, of a fetid character. This circumstance is a strong indication of the nature of the case. In other instances, after the bladder has been apparently emptied, the point of the catheter accidently enters the sac, and a flow of urine unexpectedly takes place. The distance to which the instrument penetrates, will here furnish a useful indication; but great care must be taken, while we employ it, lest the point should penetrate through the thin walls of the cyst.

For the treatment of encysted bladder, little can be done beyond obviating the effects of retention of urine. The morbid condition of the bladder does not admit of any remedy, and we must confine ourselves to the object

of removing any obstacle which may exist to the evacuation of the bladder, while we endeavour, by the occasional use of the catheter, to draw off any fluid which may have accumulated in the cysts. In this we shall be aided by injecting the bladder, and then exercising pressure on it in different directions.

A morbid condition of the bladder, somewhat analogous to the above, may be produced by irregular contraction of the muscular fibres, whereby the bladder appears to be divided into two cavities.

Dr. Baillie remarks,—"I have not had an opportunity myself of examining this singular disease, but I have received an account of such a case from Dr. Ash, which had many years ago fallen under his observation. The upper chamber of the bladder in this case was generally much distended with urine, so that a round tumour could be easily distinguished by the touch above the pubes. When a catheter was introduced into the bladder, a few ounces only of urine came away, and the tumour above the pubes remained as before. When the patient stood up, a quart of water sometimes passed away involuntarily, the tumour very much subsided, and the complaint was relieved for the time. After the death of the patient, the bladder upon examination was found to be divided into two chambers by a strong membranous substance, and the aperture of communication was almost obliterated."

There seems to me to be only two ways in which a division of the bladder into two chambers can happen. One is by a morbid growth of the inner membrane, forming a ridge at some particular part, and at length, by a continuation of this process, making a septum

more or less complete in the bladder. I have seen the cavity of the œsophagus very much narrowed at one part by a permanent ridge being formed in its inner membrane. Something of the same kind I have also seen in a part of the small intestines. We may therefore readily admit the possibility of a similar process taking place in the inner membrane of the bladder. Another way in which the bladder may be supposed capable of being divided into two chambers, is by a very strong contraction of its transverse muscular fibres at some particular part. This will be analogous to the hour-glass contraction of the uterus, which is known occasionally to take place. When a complaint of the bladder depending upon its being divided into two chambers has been temporary, it is reasonable to suppose that it has arisen from the last cause; when it has been permanent, it is more likely to have arisen from the first.

When two chambers are just beginning to be formed in the bladder, very little inconvenience is probably felt, because the communication between them at this time is very large. Under such circumstances, it seems hardly possible to detect the nature of the disease in the living body; but when the disease has made considerable progress, and the communication between the two chambers has become very narrow, it may be ascertained, or at least presumed with some probability, to exist, from the following circumstances:—There will be a considerable circumscribed tumour above the pubes in the situation of the bladder when distended; much less urine will be made than the natural quantity, and the tumour will not be sensibly lessened by it; or if a

catheter be introdued, little urine will be evacuated, and the tumour above the pubes will still remain the same. But it may occasionally happen, by some particular attitude of the body, that the urine passes from the upper chamber of the bladder into the lower, and from this it is evacuated by the urethra: under such circumstances a much larger quantity of urine will be passed than usual, the tumour above the pubes disappears, and the patient receives immediate relief, to continue till another accumulation of fluid takes place in the bladder.

CHAPTER IX.

INFLAMMATION OF THE PERITONEAL COAT OF THE BLADDER, AND OF ITS SUBJACENT CELLULAR TISSUE.

There is one other variety of acute inflammation of the bladder that demands our attention. I allude to that of its peritoneal coat, and subjacent cellular tissue. This is seldom confined to the bladder; it generally extends over the whole of the membrane, and is often the close of a fatal disease of this organ. That it takes place, however, under other circumstances, without any dangerous consequences, is sufficiently proved by the old adhesions occasionally found connecting this part to the omentum, to portions of the intestine, to the uterus, or to the rectum.

On dissection, we not unfrequently find the abdominal or peritoneal coat of the bladder inflamed, as well as the mucous and deeper tissues. Inflammation sometimes attacks the peritoneal covering, having spread to it from another part of the membrane. Nevertheless, though the circumstance is rare, cases have occurred in which acute inflammation was limited to the peritoneal tunic of this organ. As a reason for limitation to this particular membrane, Dr. Baillie suggests the quantity

of cellular tissue interposed between the serous and muscular coats, and the laxity of their connexion.

The pain and its aggravation on pressure, the state of the pulse, the countenance, and the position of the body, clearly indicate the nature of the disease. The same treatment which is employed in general peritonitis must be adopted in inflammation of the peritoneal covering of the bladder. The lancet, leeches, calomel and opium, and warm applications, must be vigorously employed. The disease rarely, if ever, proceeds to suppuration; but coagulable lymph is sometimes thrown out on the inflamed surface, forming adhesions with some other part of the peritoneum, where it covers other viscera, or lines the cavity of the abdomen.

The inflammation of the external covering of the bladder is, moreover, generally connected with inflammation of the adjoining lining of the pelvis. In these cases there occurs a peculiar train of symptoms, requiring a different plan of treatment from that suited to inflammation of the peritoneal coat of the bladder.

The pulse is rapid, varying from 100 to 140 in the minute; the skin is hot, the tongue dry, and the countenance anxious. The patient complains of pain and tenderness upon pressure in the hypogastric region. The abdomen next becomes tympanitic, the pulse intermits, and hiccough occurs. In many cases delirium ensues; but I have known the mind retain its clearness to the last. Rigors sometimes precede death. The morbid appearances observed are—infiltration of serous fluid around the neck of the bladder, and, between this organ and the rectum, sloughing of the areolar tissue,

discoloration of the peritoneum covering the bladder and rectum, with occasional effusion of a small quantity of lymph upon its surface. Now, this is not a case of uncomplicated peritonitis. The disease spreads from the areolar tissue to the serous membrane, and remedies directed to the removal of the morbid condition alone would prove of little avail. Abstraction of blood hastens the fatal termination; while stimulants may prolong life, if they do not save it. Sometimes the cellular tissue around the bladder is the seat of chronic disease; and abscesses may form in different parts of it, without the bladder being affected. These cases are always involved in great obscurity, and often terminate fatally.

Dr. Elliotson* relates the case of a female, forty-two years of age, in whom an abscess formed between the bladder and the symphysis pubis, which terminated fatally in about two months from the commencement of the disease. She complained of violent pain in the hypogastrium and over the pubes, shooting back to the loins, and frequently attended with a sensation of numbness and tingling in the right thigh, extending to the toes. The hypogastrium and pubes were very tender to the touch; there was, occasionally, a copious discharge of puriform matter from the vagina, tinged with blood; and the urine generally passed freely, but had sometimes been retained for two days together. There was much tenesmus with pain in the rectum; the tongue was white; there was no appetite, but frequent nausea; the bowels were usually opened twice a day, and the pulse was weak and small.

* Med.-Gaz., vol. i, p. 130.

On examination, an abscess was found in front and deeply behind the symphysis of the pubes, extending laterally beyond the abdominal rings, so that the round ligaments passed through it. The surface of the bone was rough, blackened, and denuded of its periosteum, but not carious. The abscess contained dark-coloured and very fetid pus, which had free exit through the urethra, a portion of the whole circumference of which was here destroyed. The suppuration was entirely anterior to the bladder, which was rather turned to the right side, but, with the uterus and vagina, was perfectly healthy. The pelvis was large and well proportioned.

Sometimes, however, there is found, posterior to the bladder, a pseudo-abscess, which is really seated within the cavity of the peritoneum, within the pouch of that membrane, lying between the posterior wall of the bladder and the rectum. The pus in these cases arises from partial peritonitis; lymph glues together some folds of the intestines, the fundus of the bladder, and the lower part of the sigmoid flexure of the colon; and into the closed sac, of which these parts thus connected form the roof, and the peritoneal pouch the floor and lateral walls, the pus is poured. The contents of this pseudo-abscess may, if small in quantity, be absorbed, and old adhesions alone remain to indicate the pre-existence of the disease. More commonly the pus finds its way into the peritoneal cavity, and death from general peritonitis follows. The inflammation on which, in these cases, the formation of pus depends, assumes a chronic character. After a short but sharp febrile attack, attended with hot skin, quick pulse,

thirst, white tongue, loss of appetite, confined bowels, with pain in passing solid stools, high-coloured urine, the evacuation of which is attended with pain in the hypogastric region, and tenderness on deep pressure immediately above the pubes, the patient becomes hectic. The febrile symptoms cease during the day, return with violence at night, and in the morning terminate with sweating. Sometimes it is the night fever of which the patient most complains, and sometimes it is the night sweats. He still has uneasiness in the pelvis, not, however, amounting to pain. If the case goes on to a fatal termination, the patient either dies worn out by the hectic, or he falls a victim to peritonitis, induced, as I before observed, by the escape of the purulent fluid into the general peritoneal cavity. In the latter case the symptoms resemble those of perforation of the intestine, but ordinarily are somewhat less violent. The treatment consists, at first, in local depletion by leeches, applied immediately above the pubes, or by cupping-glasses placed over the sacrum; calomel and opium administered every few hours, so as gently to affect the gums; hot fomentations, or bran poultices to the hypogastric region; mild aperients and simple enemata; the diet being strictly antiphlogistic.

When hectic symptoms show themselves in such cases, the treatment must be decidedly restorative. The patient must be supported with strong broths, jelly, &c. In some cases a little wine must be allowed. At the same time vegetable bitters and mineral acids will be found of considerable advantage. Quinine or decoction of bark, and dilute sulphuric acid, are the best of their class.

CHAPTER X.

MALIGNANT TUMOURS OF THE BLADDER.

The bladder, like other organs of an analogous structure, is subject to tumours of a benign and malignant nature, many of which give rise to most distressing symptoms.

Cancer of the bladder is not a frequent disease; neither is it extremely rare, for I have met with several examples in my own practice. It may occur as scirrhus or as medullary cancer. The former species of malignant tumour is, according to the testimony of all authors, an exceedingly rare affection. I have never witnessed a true example myself, and most surgeons engaged in extensive practice bear testimony to the fact, that the bladder is rarely the primary seat of true scirrhus.

Scirrhous ulcerations may of course extend to the walls of the bladder from the uterus, rectum, or neighbouring parts, but even in these cases Mr. Travers doubts whether the ulceration be of a true scirrhous character. "Scirrho-cancerous ulceration of the bladder," Mr. Travers* says, "I never saw; scrofulous often,

* Med.-Chir. Transact., vol. xviii.

particularly in children. When the bladder adheres extensively to the rectum in cancer of the latter, and when they communicate by a fistulous aperture, so that air passes by the urethra as well as feculent urine, I have not seen the coats of the bladder presenting the appearance of scirrhous cancer. The vagina and rectum in the female, on the contrary, are undistinguishably affected by the scirrhous ulcer and fungus."

Medullary cancer of the bladder is met with under two forms. In one we have the ordinary medullary tumour, the other form presents itself as "villous cancer," the malignant medullary fungus or well-known cauliflower vegetation of many authors. Scirrhus and medullary cancer may, however, co-exist in the same bladder. Mr. Solly relates a case in which the principal tumour was medullary, while several small nodules of scirrhus were disseminated through the submucous tissue.

The medullary cancer of the bladder may be either soft or firm; collected into a separable tumour or infiltrated. This last form is rare; it presents itself as a soft white pulpy substance, interspersed with creamy matter, and is infiltrated through the submucous tissue, which is much increased in thickness, while the surrounding tissues are also rendered more dense. The infiltrated matter usually occupies the sides and posterior wall of the bladder; at other points the medullary substance may be collected into small tumours.

In some cases we find a soft medullary tumour, which often springs from the neck of the bladder, or even the prostate, and projects backwards into the vesical cavity; the tumour may also arise from the

sides or posterior wall, and occasionally from the upper and anterior part of the organ. It is generally superficial, but it may be developed in the substance of the bladder; and Mr. Bully has related a case in which the medullary mass was developed beneath the peritoneal coat.

Villous cancer, a variety of the medullary, is the form in which malignant disease of the bladder most frequently presents itself. It has been confounded with benign tumours, under the vague denomination of "fungus," and therefore requires a more particular description.

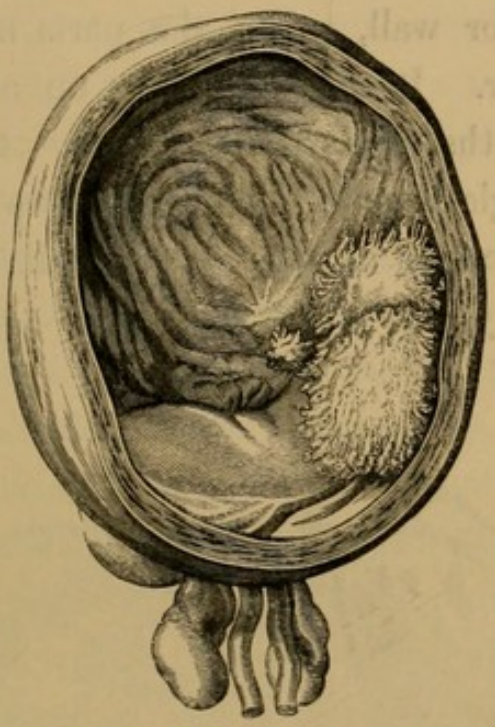
Medullary cancer is originally developed in small masses between the mucous and muscular coats of the bladder, but I believe that the "villous" form springs from the mucous membrane. The morbid growths present a variety of appearances; they are sometimes single, but in many cases, some of which I have witnessed, several tumours have sprung from different parts of the bladder. In volume they vary from the size of a nut to that of an orange; they may be as large as the closed fist, filling the whole cavity of the bladder, or constituting a tumour which has been felt through the walls of the abdomen.

The peculiar characters of malignant growths have not been carefully studied until lately, yet it is essentially necessary for us to be familiar with their intimate structure and general characters, without which it is impossible to distinguish those which are malignant from benign tumours, which may bear a certain resemblance to them. A great number of cases of vesical tumour related by different authors are

rendered comparatively useless, because it is impossible to determine, from the imperfect descriptions given, whether the tumours were of a simple or malignant kind.

The villous cancer of the bladder is well described by Mr. Paget, who says that,—"The tumour is often attached to the mucous surface by a narrow base, and hangs pendulous into the cavity of the bladder. The base and central part may be soft or firm, but all the unattached portion is very soft, shreddy, and flocculent, like the surface of the chorion. It is covered with fine villous processes, which are usually of a bright or dark red colour, from the numerous blood-vessels they contain. According to Rokitansky, the growths may be diffused, consisting of numerous single tufts scattered over a wide extent, or there may be a collection of delicate spongy excrescences rising from a circumscribed space. The stem of each excrescence consists of a fibroid membranous structure, on which the branches and villous flocculi are borne in dendritic vegetation. This latter, in its development, assumes the arborescent or peculiar appearance whence the name cauliflower has been derived. The blood-vessels of this vegetation or sprout have a peculiar arrangement; they are generally large capillaries, running along the contour of the vegetation, forming frequent loops, and supplying to the stem, as well as to each of the sprouts and branches, an ascending and descending vessel. In structure, the vegetation of a villous cancer often contains, together with its blood-vessels, a quantity of elementary granules, nuclei, and cells, especially at

the ends of its sprouts; structures less simple, and laminated cells on its exterior, the elements of a medullary or melanotic cancer-juice adhere to it, consisting of nucleated cells of various shapes, which form a soft deposit, and are often present in such quantity that they make up the greater part of the morbid mass into which the vegetations seem to grow."*



VILLOUS CANCER OF THE BLADDER. COPIED FROM SIR E. HOME'S OBSERVATIONS ON THE PROSTATE GLAND, VOL. II, P. 49, PL. X.

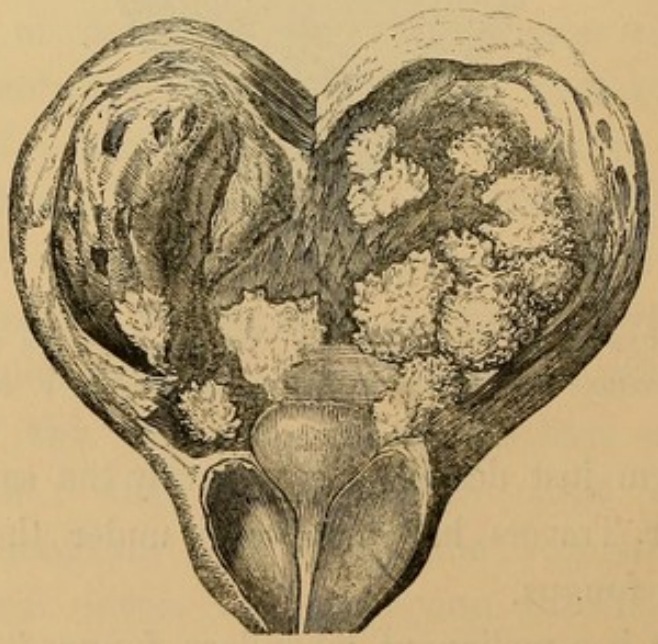
The form just described is evidently the same as that which Mr. Travers has mentioned under the name of medullary fungus.

"There is a malignant medullary fungus," says Mr. Travers, "of the mucous coat of the bladder, resembling that of the nares and uterus, breaking, bleeding, and reproduced as quickly as it is displaced. Portions of

* Paget on Tumours, vol. ii, p. 508.

fungus and coagula of blood become plugged in the urethra, and form firm pellets, so as to produce retention. It is a very painful disease, it keeps the patient in constant anxiety to void urine, which is more or less tinged with blood, and frequently he passes blood alone."*

The villous cancer may spring from any portion of the mucous membrane, but most frequently it is attached to the posterior wall, or to the parts about the neck of the bladder. It may be made up of several independent growths, pressed so closely together as to simulate a single tumour. In some cases the base of the tumour is prolonged deeply into the walls of the bladder, and is of a very firm consistence.



FUNGOID TUMOUR OF THE BLADDER, WITH ENLARGEMENT OF THE MIDDLE LOBE OF THE PROSTATE.

* L. c., vol. xviii.

As the morbid growth becomes developed, it may produce various secondary lesions, according to its seat, and the direction which the tumour takes; sometimes it closes the internal orifice of the urethra; at other times it fills nearly the whole cavity of the bladder, or it may block up one or both ureters, exciting the well-known symptoms of suppression of urine.

In a few cases the cancerous mass causes displacement of the bladder, or raises it up above the pubes, encroaching on the abdominal cavity; unlike scirrhous cancer, it seldom, if ever, gives rise to perforating ulcer of the neighbouring parts. In one case, related by M. Civiale, three fistulous openings existed between the cancerous mass and the rectum.

Although the functional disturbance from cancerous disease of the bladder is severe during life, the lesions of that organ discovered after death are not very remarkable. The muscular fibres of the bladder are commonly contracted and hypertrophied; the mucous membrane is often injected, and as if ecchymosed, but inflammation or ulceration has not been observed; in short, with the exception of the tumour, the urinary passages are more frequently healthy than otherwise. In one case I found the walls of the bladder so softened that it gave way while being removed from the body. The prostate may be engorged, or may contain some medullary nodules, though this is rare. The kidneys, however, have usually suffered from the long-continued impediments to excretion of urine; the ureters are frequently dilated on one or both sides; the pelvis also may be dilated, and contain fetid purulent urine.

Cancerous deposits are sometimes found in other

parts of the body; in about one fourth of the cases, according to my researches. In one case it was found in the veins; in another, the glands of the pelvis and abdomen were greatly enlarged, and contained medullary matter; in other cases it was found in the liver, lungs, and heart. I have omitted to mention that the villous surface is sometimes covered by a layer of phosphate of lime. The complication with stone I do not notice, because cases of calculus, with malignant or other tumours, should be obviously excluded. When the two diseases co-exist, it is impossible to say what lesions or symptoms belong specially to either.

When we attempt to trace the cause which gives rise to these cancerous formations in the bladder, we naturally inquire whether any long-continued source of irritation, such as the presence of a stone, exercises an injurious influence in this respect. It is now well known that local causes will in some cases determine the development of cancer. I have seen many cases in which fungous growths, connected with the gums and mucous membrane of the tongue or cheek have been clearly traced to the local irritation of a decayed tooth or piece of dead bone. But I am not quite prepared to say that cancer of the bladder is in any way connected with the presence of a calculus. We have no satisfactory evidence upon this point. The number of patients who have for years suffered from the irritation of a stone, without any other bad effects than those produced by chronic inflammation of the mucous membrane of the bladder, induces me to believe that the cause of these malignant vegetations is deeper seated, and that it is to be referred to some individual peculiarity, or to some hereditary

taint, which is now by modern investigation well known to exercise in a most important manner the development of the whole class of those intractable affections included under the head of cancer. Besides, cancerous disease of the bladder occurs much more often independently of stone than in conjunction with it.

On the other hand, M. Civiale is inclined to think that the long-continued irritation of stone in the bladder is not without influence in the development of fungoid and other tumours about the neck of that organ.

The symptoms accompanying this disease are obscure at the early stage, and all surgeons are agreed on the difficulty of detecting morbid growths in the bladder, at an early, or indeed at any period of their formation. This difficulty mainly arises, I believe, from the circumstance that no practitioner, however large his experience, sees more than a few cases of the complaint; and from so limited a number, he is unwilling to draw any general conclusions.

The symptoms of malignant disease of the bladder are, no doubt, in some points of view, equivocal, and the diagnosis is sometimes difficult, but the more I see, of villous cancer at least, and the more I examine well-observed cases of that disease, the more am I convinced that the obscurity and difficulty alluded to have been greatly exaggerated. Taken as a whole, these cases of villous cancer of the bladder, now appear to me as distinct and almost as readily distinguishable as any other group of urinary diseases.

In describing the symptoms which attend this complaint, it is necessary to repeat that, for the reason

already given, I have carefully excluded cases in which the malignant tumour was accompanied by calculus in the bladder.

The essential symptoms of this disease are pain in the region of the bladder, frequent and painful micturition, hæmorrhage from the bladder, and occasional retention of urine. These symptoms present themselves in every case without exception; and when taken singly, any one or more of them may depend on a variety of causes. Yet the constant manner in which they coexist, their gradual progression, the absence of certain symptoms, and the presence of other corroborative signs, afford as strong presumptive proof of the coexistence of malignant disease, as we can obtain at any time, from the rational signs of calculus. Both diseases, it is true, have a positive sign; in the one case furnished by the sensations which arise on striking a metallic body against the calculus; in the other, from an examination of any debris of the malignant body which may be discharged.

The symptoms of malignant disease of the bladder may set in suddenly, or may be developed in a gradual manner. We can readily understand how the tumour may remain indolent for a certain time, until, from its size, accidental displacement, rupture of its blood-vessels, &c., either hæmorrhage, or impediment to the excretion of urine, suddenly ensue. Observation confirms this; and, accordingly, we find that the disease manifests itself suddenly, in about a quarter of the cases. Sometimes the earliest symptom is a sudden, and, perhaps, copious discharge of blood from the urethra;

this is soon followed by pain in the bladder, and difficulty of making water. In other cases, the disease commences with a sudden attack of severe pain either in the region of the bladder, or in the back and loins; here, also, the first symptom is soon followed by hæmaturia and painful micturition.

More frequently, however, in the proportion of about two to one, the disease is developed in a gradual manner. It commences in or about the region of the bladder; the pain continues for an uncertain period, being sometimes intermittent, sometimes dull, but in the majority of cases severe, and constantly progressing. After some time, the pain is attended by irritability of the bladder, and the urine soon contains more or less blood, sometimes merely streaking the urine, but often collected in clots, or passed in considerable quantity. The irritability of the bladder gradually increases, and often gives rise to complete spasm of the organ. The desire to pass the urine becomes more and more frequent, until the patient is tormented every half hour, in some cases every ten minutes, enjoying no rest either day or night. The discharge of the urine is always painful, and the difficulty of micturating increases, until at last only a few drops may be passed at a time, the patient undergoing the most excruciating agony from violent straining, and spasmodic contractions of the bladder.

During the course of the disease, the constant discharge of urine is sometimes replaced by complete retention. On examination, this may be found to depend on the presence of a clot at the neck of the bladder; or impediment from the tumour, which blocks up the in-

ternal orifice of the urethra, or from pressure of the malignant growths on the orifices of the ureters.

The condition of the urine varies with the progress of the disease. At first it is high coloured, and contains an increased quantity of mucus; next, it becomes tinged with blood; then fetid, purulent, and holding in suspension various heterogeneous matters.

In a few rare cases the disease may continue for years, but commonly it progresses from bad to worse; at the termination of twelve or sixteen months the patient sinks, worn out by pain, hæmorrhage, and hectic fever.

It is worthy of remark that, even in protracted cases, the patient seldom exhibits the peculiar countenance which is said to characterise a malignant diathesis.

Having thus given a general sketch of the disease, it may be useful to notice each of the essential symptoms in detail, and describe some points which may throw light on the nature of the complaint.

The pain which is first felt either sets in suddenly or is gradually developed. It presents several varieties with respect to its seat, intensity, and character. The painful sensations experienced by the patient are, moreover, distinguishable into two kinds; the one is more immediately connected with the tumour itself, or its direct effects on the adjacent tissues; the other kind of pain evidently depends on the violent efforts of the bladder to expel the urine and foreign body, which act as constant irritants of the mucous membrane.

The former kind of pain alone can be said to be proper to the disease; the latter is a symptom common

to stone, retention of urine, and many lesions of the urinary passages.

The essential pain now spoken of, when it commences suddenly, is confined to the bladder or to the lower part of the back; in this latter case, it soon extends to the bladder likewise; and, in both, it is of a severe nature. When the disease is less suddenly developed, we find the patient complaining of some uneasiness about the region of the bladder, or of irregular or intermitting pains in that part. In other cases, the pain commences about the loins or hips. It may thus continue for several months, with alternations of severity and relief; or it may be very severe from the first, in the region of the pelvis and the loins. The character of the pain presents nothing of a special kind. In the early stages of the disease the patients usually refer merely to varieties in its intensity, and rarely if ever speak of it as being of the lancinating, darting kind.

As the disease advances, however, and as the irritability of the bladder becomes increased, lancinating pains are occasionally experienced, or there may be a cutting, darting pain, which radiates in several directions towards the rectum, into the perinæum, or along the urethra.

It is obviously difficult to determine how far the pain, in this more advanced stage, depends on the tumour itself, or on the irritability of the bladder, and secondary lesions which its presence may have determined.

In no case has the peculiar pain of the glans penis, so characteristic of stone, been observed.

The seat of the pain is not generally well defined; but in some cases it has been referred to the neck of the

bladder; in others, to the lower part of the back, and vicinity of the rectum; while in others, again, the pain has been chiefly experienced above the pubes, and in the lower part of the abdomen. The different points from which the tumour springs will explain these varieties; and it should be observed that the bladder is sometimes painful to the touch, when examined with the finger through the rectum, or when pressure is made above the pubes. In almost every case the pain goes on gradually augmenting; but it is difficult to appreciate this increase, the essential pain being, sooner or later, masked by severe spasm of the bladder.

Next to the pain, the chief symptoms of malignant disease of the bladder, are irritability of the organ, and impediment to the excretion of urine. These are constant symptoms, observed in every case without exception.

The irritable condition of the organ is evinced by a frequent desire to pass urine, and by the uneasy sensations or pain which accompany its excretion. These symptoms usually set in at an early stage of the disease, and continue to increase until its termination. The degree of the irritability varies, for it depends on many circumstances connected with the rate of development of the tumour, its seat, the changes it may undergo, or give rise to, &c.; but its intensity bears pace with the development of the disease. Slight at first, the irritable condition of the bladder increases, either gradually or rapidly, until the unhappy patient is called on every five minutes to evacuate a bladder, from which only a few drops of urine are expelled after inconceivable agony.

According to Dr. Warren,* a discharge of blood with the urine is the first sign of this disease; while other surgeons and authors affirm that hæmaturia is far from being constant. Both the opinions are erroneous. The complaint sometimes commences with hæmorrhage from the bladder; but not frequently: in about one-eighth of the cases perhaps; while, on the other hand, every case of medullary cancer of the bladder, which I have attended myself, or met with in books, has been attended by more or less discharge of blood, through the urethra. The hemorrhage is sometimes both sudden and copious. Generally speaking it follows the gradual course of the disease, being slight at first, then augmenting as the contractions of the bladder become more violent; and in some cases proceeding to a degree which threatens life.

The structure of medullary and villous cancers sufficiently explains the constancy of this symptom: for it would be strange indeed if the fine capillaries of the villous tufts should escape under the violent contractions of the bladder, which the tumour, at some period or another, is certain to excite. The discharge of blood generally takes place at the same time as the evacuation of the urine; in other words bloody urine is passed, the fluid being merely streaked, or containing clots of blood in considerable quantity; but in some cases pure blood is discharged from the bladder without any admixture of the urine. In other cases the loss of blood takes place after the bladder has been naturally or artificially evacuated, and this is a circumstance which should

* On Tumours, p. 393.

attract attention. The exploration of the bladder with instruments, almost always excites hæmorrhage, as we might, indeed, naturally expect it should.

The condition of the urine has not been carefully examined in many cases of malignant disease of the bladder. Authors content themselves with stating vaguely that the urine is fetid, turbid, purulent, &c. These characters it usually presents whenever the disease has made any progress. In the few cases which have been accurately examined, the urine was offensive, sometimes acid, sometimes alkaline; it contained in the former case, lithate of ammonia, in the latter, crystals of the triple phosphate; it also contained pus and blood-globules with organic shreds, apparently of mucus and fibrine. In a few cases, cells and cancer-elements were discovered under the microscope.

The diagnosis of malignant disease of the bladder is attended by many difficulties; but I feel persuaded that many of these may be overcome by close attention to all the circumstances of each case.

I have shown that the essential symptoms consist in pain of the bladder, irritability, painful and frequent micturition, and hæmaturia. It has been objected, and with much truth, that all the essential symptoms above enumerated may arise from other lesions of the bladder, and therefore possess no character diagnostic of malignant disease. This is undoubtedly the fact, and cases may arise in which, from the difficulty of pursuing our investigations, it may be impossible to arrive at a correct diagnosis. Much more frequently, however, it happens that, on examining the bladder, we discover that those lesions which often give rise to the signs

enumerated are absent; that we can establish the existence of a tumour within the cavity of the bladder; and that the only obscure point which remains is,—whether this tumour be of a benign or malignant character; even this obscure point has been more than once cleared up by modern science, and I entertain the belief that the obscurity will diminish as science progresses, and the attention of competent observers is directed towards it.

In describing the symptoms of malignant disease of the bladder, I have only noticed the rational signs of that complaint, leaving the physical signs for the subject of diagnosis.

Let us suppose that a case presents itself with the symptoms already enumerated. Their nature and severity are such as to remove the notion of functional derangement; they must depend on some serious organic lesion.

What then are the lesions which may produce the violent pain, constant spasm, and persisting hæmaturia of malignant disease? How far do the rational symptoms indicate the presence of a tumour, rather than those of a calculus, &c.? By what physical signs can we determine the existence of a tumour in the bladder? and finally, in what manner, or by what means, are we to distinguish between benign and malignant tumours of the organ?

These are the principal questions, on the solution of which, as it seems to me, we should endeavour to establish our diagnosis. Let us follow out the rational symptoms first, and see what light they throw on the nature of the disease; that light is doubtful and un-

certain, but may serve as a guide to the right path. Malignant disease of the bladder may be indolent, that is to say, unattended by any symptoms for some time, and then manifest itself suddenly. The sudden attack consists in the occurrence of severe pain in the region of the bladder, or of copious hæmorrhage from that organ. The pain, or the discharge of blood, whichever it may be, continues as the sole symptom for several months perhaps, and is then followed by a gradually increasing difficulty of making water, and the other symptoms already enumerated. On examination, the urinary passages are found to be free, and no calculus is detected in the bladder.

The disease has originated in this manner in about one fourth of the cases; and this peculiar mode of origin appears to me highly characteristic of the malignant affection.

I am not acquainted with any other organic disease of the bladder which commences in the same way. Stone and ulceration are the diseases which bear the closest resemblance to malignant tumour of the bladder, yet their earlier symptoms and course do not present anything resembling the conditions just mentioned.

The pain experienced by persons labouring under this disease is seldom of a peculiar kind, or attended by any circumstances which lead us to detect its origin. The only point worthy of notice which I have remarked, is that it is more frequently confined, during the early stages at least, to the back and region of the bladder, than the pain resulting from calculus. It seldom extends along the urethra, and is never fixed in the glans penis; the pain, moreover, may occur and persist

without any other symptom of disease in the bladder, a circumstance rarely observed during stone, and never during ulceration. This may perhaps depend on the fact that malignant disease of the bladder may continue for a long period, and even to the time of death without exciting any disease of the mucous membrane or urinary passages, whereas calculus is often attended by chronic inflammation, ulceration, enlargement of the prostate, &c.

The tumour acts like any other foreign body, and excites frequent desire to make water, the contractions of the bladder being extremely violent and painful. These symptoms may be produced by anything which irritates the bladder, or causes an obstacle to the discharge of the urine. Hence a frequent desire to make water, accompanied by painful efforts, or even spasm, is common to several affections of the bladder and prostate gland.

The sudden retention of urine, coming on after painful micturition and frequent hæmaturia, is a sign of greater value; but it can only serve as a diagnostic sign of tumours, in those cases where an examination may have shown that the obstacle to the evacuation of the bladder does not depend on calculus, enlargement of the prostate, stricture, or any of the ordinary causes of retention.

The indications to be drawn from the presence of blood in the urine, and especially from the discharge of pure blood from the bladder, are, in my opinion, of greater value than many surgeons are disposed to admit.

When we consider that malignant disease of the bladder generally assumes the form of villous cancer; that the dendritic vegetations of this growth are at once

extremely vascular and soft, giving way and bleeding under slight pressure, it is not to be wondered that the powerful expulsive efforts of the bladder should often be followed by hæmaturia, or even true hæmorrhage from the bladder.

In every case with which I am acquainted, more or less blood has been discharged from the bladder during the course of the disease, and with a constancy which no other lesion of the bladder presents. The first symptom of the complaint may be a discharge of pure blood from the bladder; and when this is soon followed by excessive pain and difficult micturition, we have a strong presumptive sign of the existence of a vascular tumour. In other cases the urine is merely tinged with blood, at first, the hæmaturia being accompanied by only slight symptoms of vesical lesion; these, however, quickly become more severe, present little or no remissions, and are soon attended by more copious loss of blood. The *early* occurrence of hæmaturia in these cases is not to be overlooked; but the most significant character is its constant occurrence during the whole course of the disease. The quantity of blood discharged may greatly diminish; the urine may even become clear for a time; but the symptom returns again and again, until the end.

Although the discharge of blood usually occurs at the time of making water, because the tumour is then most exposed to pressure or irritation, yet hæmorrhage may occur while the patient is at rest and the bladder empty.

This is a circumstance which should not be overlooked, and points to villous cancer as the source of the hæmor-

rhage. The great increase of the hæmorrhage sometimes occasioned by the use of instruments during examination of the bladder, may also be taken into account. The use of the sound may be followed by some discharge of blood under several circumstances; but the hæmorrhage is rarely abundant, unless the bladder be the seat of a vascular tumour. It has been justly observed, "that the blood may come direct from the urethra, prostate, or kidneys, as well as the bladder, and that an error of diagnosis, as to the seat of the hæmorrhage, may be readily committed." The experienced practitioner will not often have much difficulty in determining whether the blood comes from the bladder or from the canal of the urethra. It is less easy to say whether the hæmorrhage may not be renal; we must look to the concomitant signs of renal disease; when the blood is derived from the kidney, the fluid discharged often contains the tubular casts indicative of disease in that organ.

In a case of fungus hæmatodes, which Mr. Mayo examined with Mr. Wilson, and in which, from pains in the bladder and occasional discharge of blood, the existence of stone had been suspected, a fungus was found attached by a narrow pedicle to the mucous membrane; the texture of the fungus was soft, and its surface shreddy and ragged.

A similar case is related by Mr. Solly in the 'Transactions of the Pathological Society.'* The patient is represented as having had the usual symptoms of stone; and on introducing the sound it came in con-

* 1849-50, page 237.

tact with a substance, which was at first, from its resistance, supposed to be a stone, but did not ring like a solid calculus. The man sank gradually. In the bladder there was a fine specimen of fungoid tumour, and two or three small scales of scirrhous tubercle. There was also a good deal of scirrhous deposit in the left kidney.

In another case, recorded in the same work,* the tumour might have been more readily mistaken for stone, inasmuch as it contained calcareous deposit; indeed, the surfaces of these and other vesical tumours are occasionally encrusted with urinary deposits.

It is unnecessary for me to discuss the points of similarity and difference between calculus and tumours of the bladder, because the rational symptoms of the former are just as deceptive as those of the latter, perhaps even more so. No surgeon would, at the present day, think of affirming the existence of calculus in the bladder, without the presence of its positive signs, derived from the use of the sound.

But the absence of these signs does not entitle us to infer positively the absence of stone.

The calculus may be in the bladder, yet out of the reach of the sound; the obstacles to complete examination are, however, now well understood, and though doubts may arise, errors of practice are seldom committed.

As the rational symptoms of malignant or other morbid growths in the bladder only lead to suspicions, more or less well-founded, the surgeon will naturally

* 1848-49, page 85.

turn to physical signs, derived from an examination of the urinary organs, and of the tumour itself, or rather of any portions of it which may be passed with the urine. By careful examination we determine the absence of those lesions which have symptoms analogous to those of vesical tumour; by exploring the bladder in a methodical manner we can generally ascertain that it contains a soft tumour; and should any portions, or even *débris* of this tumour have come away with the urine, the microscope will enable us to ascertain whether it be of a benign or malignant nature.

It is a remarkable circumstance, that the urethra and prostate gland seldom present any serious organic lesions in cases of malignant disease of the bladder. The mucous membrane of the bladder is also remarkably free from disease; the most common change of the organ observed being some degree of hypertrophy and contraction. It would not appear that this exemption from secondary disease accompanies benign tumours, which so frequently spring from the neck of the bladder or prostate: if any reliance can be placed on the numerous examinations published relative to malignant tumours of the interior of the bladder, they indicate, I repeat, a remarkable exemption from secondary lesions of the urinary passages and mucous surface of bladder.

On examination, then, the surgeon will frequently discover that the urethra, prostate and neck of the bladder, are free from organic disease, and this discovery will considerably restrict the field of his inquiries, showing that the cause of disease is limited to the bladder.

This organ should now be carefully explored in its

turn; a few ounces of tepid water are injected into the bladder, and a catheter, the curve of which is short, is introduced. The extremity of the instrument may be arrested a little beyond the internal orifice of the urethra, or it may pass freely into the bladder.

In the latter case, by slowly revolving the point, and by making the end of the instrument sweep, as it were, the fundus and sides of the bladder, it will rarely happen that the existence of a tumour is not discovered. Unless the morbid growth be very large or placed in a particular position, the presence or absence of stone may be, at the same time, determined.

The existence of a tumour in the bladder, taken with the rational symptoms which I have described, is strong presumptive proof that the morbid growth is of a malignant nature.

But positive proof as to the nature of the tumour is still wanting. This can only be obtained by microscopic examination of any portions of the morbid growths which may happen to be discharged with the urine. In one case, which occurred in my own practice, a correct diagnosis was thus formed; and other cases have, I believe, since then occurred in the practice of other surgeons.

The peculiar structure of villous cancer, and the quantity of nucleated cells collected on the surface of the dendritic vegetations, render it certain that these cancer-cells may be discovered in the urine, even independently of the discharge of fragments of the morbid growth itself. They should be sought for in the urine passed during severe paroxysms, especially when attended by copious discharge of blood.

In cases complicated with stone, great enlargement of the prostate, an irritable state of the neck of the bladder, &c., the difficulty of forming a correct diagnosis is increased, because the coexisting lesions render our modes of exploration often difficult and sometimes impossible. The only element of diagnosis within our reach, in many of these unfortunate cases, is the presence of cancer-cells in the urine.

Referring to malignant disease of the bladder, Dr. Owen Rees* observes, "fortunately, we have the means of determining the real nature of the affection, even before sounding has been practised, and that, too, in a very satisfactory manner. When such a case comes before us, we should always make a careful examination of the deposited blood-corpuscles. If the hæmorrhage have been caused by vesical calculus, we shall observe these bodies mixed merely with any one or more of the ordinary organic or sedimentary matter. If, on the contrary, the malignant growth have attained any size or development, a diagnostic sign is present, to which experience has shown me great confidence is due. It consists in the presence of cells characteristic of malignant growth. These, which are intimately intermixed with the blood-corpuscles, have an appearance unlike that of any of the ordinary matters deposited from the urine, and afford us a means of diagnosis and prognosis such as can scarcely be attained by any other method of investigation." After describing the appearance of cancer-cells, Dr. Rees adds, "from many years' experience

* On Calculous Disease and its Consequences. London, 1856, p. 52.

in the examination of urinary deposits, I can affirm that I have never seen corpuscles like those in the urine, except in cases of malignant disease."

The following cases will serve to illustrate the symptoms and progress of malignant disease of the bladder. In the spring of 1848, Dr. Lankester was consulted by a gentleman, æt. 62, of small stature, active and temperate habits; he had, nevertheless, suffered much from dyspepsia, for which he had consulted medical men, and latterly had been compelled to attend to his diet with more than ordinary care. About twelve months before Dr. Lankester saw him, he was suddenly attacked, while working in his garden, with pain in his back, followed by a desire to make water, which, when passed, he found to be discoloured with blood. He immediately sought for medical assistance, but the pain in the back continued, and there was a fresh appearance of blood in the urine. He lost flesh as well as appetite, and his nights were sleepless; the frequency of the desire to pass water increased, and the pain in the back continued, extending thence down the thighs. Under these circumstances, it occurred to his medical attendant, that stone in the bladder was the cause of his symptoms, and he was sounded more than once, but without any stone being found. When seen by Dr. Lankester he was very thin, with an anxious countenance, and peculiar stoop in his gait. He suffered much from dyspeptic symptoms and severe gastrodynia; the bowels were habitually constipated, and never relieved without medicine. He was restless at night, and obliged very frequently to get up and make water; there was severe pain in the back and in the region of the bladder above the pubes, where

pressure caused severe suffering. The urine passed every hour or hour and a-half was sometimes more coloured than at others. It was acid; and after standing a considerable time, threw down a deposit, which, under the microscope, presented lithate of ammonia and organic shreds, apparently of mucus and fibrine. Blood-corpuscles and pus-globules, could also be detected. On applying heat and nitric acid, albumen was precipitated. After a variety of treatment, he consulted an eminent surgeon, who passed a catheter, and endeavoured to inject the bladder. The operation was attended with great pain, and followed by an increased amount of blood in the urine. It was found impossible to get the fluid to pass into the bladder, although the catheter was fairly beyond all possibility of prostatic obstruction. After a few months, he again came under the care of Dr. Lankester. He was greatly emaciated; the pain in the back and region of the bladder was constant and intense; the urine was passed more frequently than ever, being sometimes clear, sometimes mixed with blood. On standing for a short time, it deposited a thick sediment, which consisted of lithates, mixed with amorphous organic matter. The use of morphia afforded some relief; but the patient became gradually weaker, and sank in the month of January, in the following year. Upon examination, the lungs and liver were found healthy; the heart of natural size, with slight deposits upon the mitral and semilunar valves. Both kidneys were enlarged, the left much more so than the right; the capsule was easily separated from the mass of the kidney; the tissue was soft and easily broken down, but there was no conversion of tissue. The pelvis contained some

puriform fluid, which was traceable down the ureter. The right kidney was the smaller; its pelvis was highly injected, and parts of its surface presented granular degeneration. The bladder was empty, and when grasped from the outside, the coats were firm; while, on opening it through the urethra, a loose organized mass of yellowish colour was found free within it. Attached to a point near the neck of the bladder, was a granulated mass highly injected, presenting portions of red colour passing into white. It was easily broken down with the knife, and yielded to slight pressure. Higher up the bladder, and on one side of the fundus, another tumour presented itself of larger size, but having the same character as that below. The mass that was loose had evidently been separated from one of the portions still in connection with the bladder. The coats of the bladder were very much thickened; the prostate was considerably enlarged, and on cutting into it, several points presented themselves, in which was found matter of precisely similar character to that of which the growth in the bladder was composed. The spleen, stomach, pancreas, and absorbent glands of the abdomen, both in the mesentery and along the course of great blood-vessels, were examined, but they presented no trace of malignant disease.

About the same time the following case came under my own care. T. S. B., æt. 50, stout, and of a gouty habit, in May, 1848, passed bloody urine for the first time, having previously had no other symptom than severe pain in the back. He continued to pass blood in the urine for five or six months, at first without pain, but afterwards with intense suffering. The blood at

the commencement was fluid and diffused in the urine, but after a short time coagula were passed, and the passing of these occasioned great pain. At the end of six months the appearance of the blood almost entirely ceased, but symptoms of chronic inflammation of the bladder came on. There was frequent desire to pass urine; great pain or scalding at the time of passing it, and afterwards the urine was loaded with stringy mucus. Some of the symptoms being those common to stone, he was sounded three or four times, but no calculus could ever be detected. The sound could scarcely be moved at all in the bladder, its motion being evidently impeded by some morbid growth, and the sounding was always attended by severe suffering. On one occasion, while the sound was being moved about, a portion of the morbid growth was detached and subsequently came away. On examination this proved to be of a malignant nature, and the diagnosis of malignant disease of the bladder was accordingly formed. His local symptom increased in intensity; his strength and appetite began to fail him, and in the following May he died. The only symptom in the case was a constant dribbling of the urine for the last two or three weeks prior to his death. On examination of the body, the bladder was found occupying the greater part of the pelvis, and fixed in its position by morbid adhesions, which extended on all sides, and were very indurated. On passing the hand between the bladder and rectum the glands along the course of the right ureter were found diseased. The right kidney itself was more than double its normal size, the other was only slightly enlarged. Both on section presented a clear surface, of an

ash-grey appearance, the natural structure was obscured, and more or less destroyed by infiltration of disease. Towards that part where the bladder is usually uncovered by the peritoneum, the part seemed much softer and readily gave way. The interior of the bladder was filled to a great extent by a morbid growth of a cancerous character, which seemed to take its origin from the mucous coat, and was much enlarged towards the neck. The mass bore a strong resemblance to the cauliflower excrescence of the uterus. In some parts, the sub-mucous tissue and muscular coats were completely absorbed, in other parts they were not much affected. The tumour has only recently been examined under the microscope, and consequently was greatly altered by spirit, but it was clearly seen to be of a most malignant character.

The following case was complicated with stone. A man, forty years of age, was admitted under my care, into St. Mary's Hospital, on the 11th of January, 1855. He stated that he had been afflicted with uneasiness while passing his urine as long as he could remember; but that it was during the last two months only that he suffered great distress, under which his general health had begun to give way. On admission he complained of great pain along the urethra and at the end of the penis, especially after making water, and also of great uneasiness in the lower part of the abdomen; the urine, which he was obliged to void frequently, was always bloody, and contained crystals of the triple phosphate, but no cancer-cells. The presence of a calculus was readily detected by the sound. The man's countenance was pale, and expressive

of great suffering. I performed the lateral operation, and extracted two calculi, but not without some difficulty, for one was on the right side of the bladder, in a sulcus formed by the tumour. There was a good deal of venous hæmorrhage during the operation, which the patient survived only two days. The bladder was found to be adherent to the surrounding structures, and its cavity was occupied by a medullary tumour, which yielded a soft brain-like substance on pressure, and exhibited, under the microscope, the true cancer-cell.

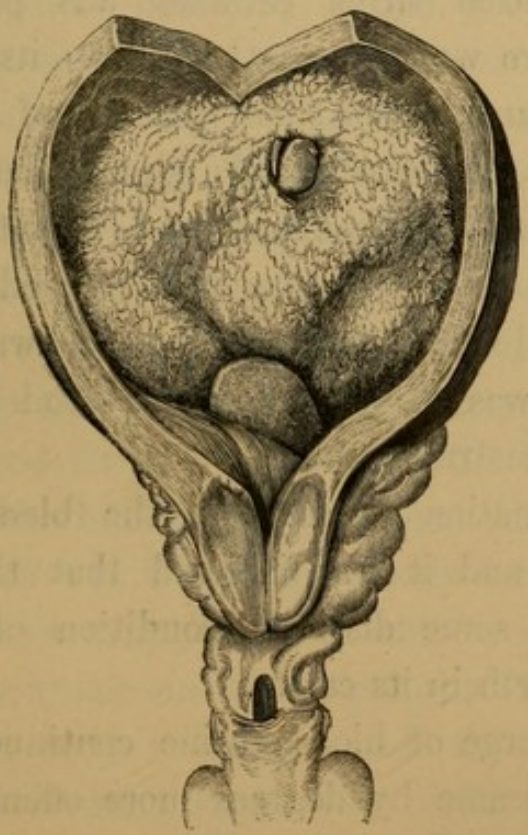


FIGURE SHOWING BLADDER WITH MEDULLARY TUMOUR AND TWO CALCULI.

J. C., 22 years of age, applied, on the 15th of November, 1853, at St. George's Hospital, on account of some difficulty in making water, attended by in-

continence of urine and hæmaturia. He stated that about a month previously he had fallen off a ladder, and struck himself, while falling, on the right side of the chest. Some three days after the accident he noticed, for the first time, blood in his urine. He then began to suffer from difficulty in making water, and he was suffering much on admission from inability to empty his bladder. The urine was dribbling away from the urethra, mixed with blood. The complexion was sallow and unhealthy, and the expression was indicative of much distress.

A small-sized silver catheter was passed by Mr. Pollock; there was no obstruction to its passage into the bladder, and only a small quantity of blood escaped through it. A small-sized gum-catheter was then pushed far into the bladder. As it entered, a small quantity of blood and coagulum escaped; but on its further introduction clear urine came away; and after the bladder was emptied of water, blood again escaped through the instrument.

On examination per rectum, the bladder felt large and elastic; and it was inferred that this effect was produced by some diseased condition of its walls or by some growth in its cavity.

The discharge of bloody urine continued; the fluid evacuated became by degrees more offensive, alkaline, and purulent. Under the microscope, numerous blood corpuscles, a copious deposit of crystals of the triple phosphate, and a large number of nucleated cells, were seen. These latter consisted of an outer cell, with a delicate investing membrane, granular contents, and a large highly granular nucleus. There were also small

masses, which probably consisted of similar cells massed together, as their outline showed a similar granular arrangement. The patient sank gradually, and died eleven days after his admission.

The kidneys were enlarged, but not diseased. The pelvis and ureters on both sides were greatly dilated. The bladder was half filled by a fungoid growth, attached to the lower portion of its posterior wall, and contained some offensive urine, mixed with pus and blood. The mass of the tumour consisted of several independent growths attached to the walls of the bladder by separate pedicles; it had grown out into large flocculent tufts, shreddy at their surface, and very vascular in their structure. The surfaces of the masses were ulcerated. It was difficult to determine whether the original disease commenced in the mucous or submucous tissues.*

Some time ago I was consulted in the case of a gentleman who was supposed to be affected with stone. He had suffered for a considerable time from pain in the region of the bladder, and frequent desire to pass the urine, which was frequently bloody and mixed with mucus. Various remedies were employed, and with some relief, for at the end of six months the pain in the bladder was greatly mitigated and the hæmorrhage from the bladder much diminished. The patient, however, remained in a debilitated state from the frequent loss of blood which he had formerly experienced.

The symptoms latterly complained of seemed referable to the urethra rather than the bladder. The urine still

* Transactions of Path. Society, vol. vi, p. 258.

contained mucus, and was occasionally tinged with blood. The discharge of urine was painful, but the patient referred his sufferings chiefly to the urethra, during the whole course of which he experienced intolerable pain while making water. It was most violent when the urine first flowed, and then gradually subsided, until the bladder was emptied, when nothing was felt except an aching sensation along the whole course of the urethra, which, however, soon passed off. The desire to pass water was experienced every hour; it was excited by standing or walking; the pain, also, was increased by exercise; but was much alleviated when the patient had remained for two or three hours in bed in a particular position on his back.

It was now thought that ulceration existed in the mucous membrane of the urethra. Balsam of copaiba produced irritation and hæmorrhage; various kinds of injection were tried, some with relief, others with no result. The muriate of morphia, in half grain doses, alleviated suffering, but produced no other effect. The patient sank in about a fortnight after I had been consulted.

On examination of the body, the bladder was found to be somewhat contracted, and the muscular fibres irregularly thickened. Attached to the fundus was a tumour about the size of a small orange. It was rather firm at the base, vascular, and of a cauliflower appearance in the body; the colour of the tumour was whitish interspersed with dark purple spots; its surface was covered with a soft, sandy deposit, consisting chiefly of the phosphate of lime and triple phosphate. The deposit was very friable, being easily crushed between the

fingers; and it should be remarked that the urine occasionally contained a similar deposit during life.

At the right side of the bladder, and extending as far as its neck, was another tumour, of similar structure but smaller in size; this was so situated that it must have occasionally blocked up the internal orifice of the urethra. The rest of the lining membrane of the bladder was dotted here and there with small, hard, reddish tubercles, between which the membrane itself appeared pale and flabby. The ureters were greatly dilated. The prostate was healthy, but a thin membranous band extended across the membranous portion of the urethra, and obstructed the passage. About three inches behind the glans penis the urethra presented a few points of ulceration, it was otherwise healthy.

The kidneys were much enlarged, and softer than natural. Their external surface was covered with elevated tubercles, about the size of hazel nuts, which broke down under slight pressure. The internal structure of the kidneys was completely disorganized, and interspersed with small abscesses filled with pus and oil-globules. There was no calculus either in the kidneys or in the bladder.

The treatment of malignant disease of the bladder is altogether palliative. The pain, irritability, and spasm of the bladder, are best relieved by full doses of morphia, which may be occasionally administered through the rectum in the form of suppository or injection. When the discharge of blood is sufficiently copious to enfeeble the patient, or, as is sometimes the case, endanger life, the patient should be kept for some time in the hori-

zontal position, and astringent remedies should be administered. Gallic acid, or the muriated tincture of iron may be tried; but the cause of the hæmorrhage is such as to leave little hope that any great benefit can be derived from the use of internal remedies. When the urine is alkaline I am in the habit of employing the decoction of pareira brava with nitric acid; if, on the contrary, it becomes acid, uva ursi with the fixed or volatile alkalies, will be the most appropriate remedy.

If the nature of the disease have been detected, all manual interference should be carefully avoided. No surgeon of the present day would, I presume, follow the example of our predecessors, and perform cystotomy, with the object of extirpating the tumour, or even attempt to crush it, as has been done in more recent times. Unless urgently required, the use of the catheter should be likewise avoided; but retention of urine may sometimes occur, and the bladder must be relieved. When the retention depends on the presence of a clot or a small pedunculated tumour at the internal orifice of the urethra, the obstacle may often be overcome; but in other cases, and chiefly from coexisting lesions of the prostate, neck of the bladder, or urinary passages, the greatest difficulty may be experienced in introducing an instrument, and the obstacles may baffle the most practised hand.

CHAPTER XI.

NON-MALIGNANT TUMOURS OF THE BLADDER—TUBERCULOSIS.

In addition to the malignant affections described in the last chapter, the bladder may be the seat of several growths of a benign nature. The history of these tumours, obscure in itself, has been rendered still more imperfect by the fact that the older writers possessed no means of distinguishing between malignant and non-malignant growths; while several of our best modern authorities on diseases of the bladder have not only described, but actually delineated, as simple tumours, growths which were evidently of a malignant character. The whole of this subject requires to be investigated anew, and in a more accurate manner. In the mean time, some of the best ascertained facts connected with these tumours may be noticed.

M. Civiale has devoted a long chapter of his work on 'Diseases of the Bladder,' to fungous tumours. After a few preliminary observations, he states, "I shall pass at once to practical matters, merely informing the reader, in order to prevent any confusion, that I apply the term

fungus or polypus to those tumours which spring from the internal membrane of the bladder, and which vary so much in their nature, that nothing general can be established in this respect."

Such a definition is not well calculated to prevent confusion; and when we come to examine most of the cases published, it is at once felt that the elements for determining the nature of the tumours described are entirely wanting.

A certain number of cases, however, has been accurately described, and from these we learn that the bladder is occasionally the seat of cystic tumour. At other times the tumours are fibro-cellular, having a polypous appearance, and varying much in consistency, being soft or firm. Lastly, the tumours may be fibrous polypi, or true fibrous tumours, the former being connected, the latter not, with the substance of the organ.

These tumours may occupy any portion of the bladder, but they are most frequently about the neck and the middle lobe of the prostate. Many of the so-called tumours springing from the prostate are, however, nothing more than pedunculated out-growths of the gland itself; as Mr. Paget well observes, they are "like tumours in their shape and relations, and like prostate gland in tissue."

The fibro-cellular and fibrous polypi are often connected to the bladder by a narrow base or peduncle; they seldom acquire a large size, and their growth is not rapid. They frequently coexist with and seem to be excited by calculus in the bladder. That the constant irritation of a foreign body should be followed by growths from the neck of the bladder, is what we can

readily understand, although it by no means follows that such tumours should be of a malignant nature.

The late Mr. Crosse, of Norwich, has related a case of polypus of the bladder which is worth recording. A child, æt. one year and a half, was troubled with frequent inclination to make water, attended with great straining and much pain. Medicine failing to relieve, Mr. Crosse at length sounded the bladder, but felt no stone. Alkalies, opiates, and the warm bath were employed; the patient always resting better on the night when the bath was taken, although his symptoms increased in severity. He was continually wet with urine, which was passed in drops, an effort being made, with violent straining, at various intervals, from a few minutes to half an hour. The nights were passed in the same manner as the days, except that during the former, the little patient was said to scream more and strain rather less violently; unless laudanum were given to him he never got any rest till the morning, when he would occasionally sleep for an hour or two. At almost every attempt to pass urine feces were passed, but the rectum never prolapsed. About every two or three weeks, Mr. Crosse used the sound gently, and twice thought he felt a stone, but not satisfactorily; the impression was conveyed on passing the sound towards the left side of the bladder. No bleeding had followed the different soundings performed during three months, and the urine was generally voided more easily afterwards, and sometimes as much as a table-spoonful at a time.

Dec. 28.—Mr. Crosse again used the sound, which was resisted by something unusual towards the left side of the bladder; for several days after this exami-

nation the urine was tinged with blood. The patient had become gradually emaciated by this time, the skin hanging flabbily about him, and the countenance presenting as expressive a picture of suffering and grief as could be witnessed. Soon afterwards another opinion was taken, but the evidence respecting the existence of a stone was unsatisfactory. Various ideas passed through Mr. Crosse's mind; he thought that a stone might be encysted at the termination of the left ureter, as it was thereabouts that the resistance was always felt. While sounding, he had frequently introduced the finger into the rectum without gaining any information, except that when the child screamed, and the muscular coat of the bladder contracted upon its contents, the organ felt as a firm tense ball, about twice the size of a walnut.

The little boy was evidently sinking under his painful disease; and when two years old it was determined that an operation should be attempted for his relief. Mr. Crosse introduced the curved staff without difficulty; the anus prolapsed from violent straining. The surgeon who assisted at the operation stated his opinion that he felt a stone; Mr. Crosse, on the other hand, could only feel a resisting body at the left side of the bladder about the termination of the left ureter. After a few minutes delay it was determined to cut into the bladder. The staff having been withdrawn during the consultation, it was re-introduced, and held in a proper position, when Mr. Crosse observed a great fulness of the perinæum. As soon as he had cut down to the staff, and opened the membranous portion of the urethra, a semi-transparent substance appeared in the

wound, resembling the mucus which had been passed from the rectum by the child's straining when first placed upon the table, and Mr. Crosse feared he had, for the first time in his life, wounded the rectum, an impression which momentarily invaded the minds of the bystanders. With the assistance of the left forefinger, guided by the staff, he carried the scalpel forward to the neck of the bladder, and on withdrawing the knife, he observed that the wound became instantly filled with a mass resembling what one would have expected to see had the peritoneum been opened, and the vermiform process, and several folds of small intestines had protruded. The protruded parts were pushed back; and on carrying the left little finger into the bladder, Mr. Crosse felt no stone, but found the cavity filled with soft tumours, and with a firmer substance near the orifice of the left ureter.

"If I betrayed," says the operator, "any judgment in this case, it was undoubtedly in this stage of the business, by relinquishing the forceps held in readiness for me, and in withdrawing my finger from the bladder." The same parts then protruded, and they proved on inspection to be tumours, connected together like a cluster of grapes, some more, some less transparent; resembling in firmness, appearance, and structure, the mild polypus nasi; the membrane by which they were connected with each other, and with the inner surface of the bladder, was long and loose enough to allow some of the tumours to hang externally dependent at the wound: they had entered the urethra by the violent straining of the child, when first placed upon the table. The nature of these tumours being now understood —namely, that they were mild polypous masses, growing

from the inner surface of the bladder, it became obvious, that the only chance for the patient's recovery must be sought by removing them. All that were in sight were cut off with the scissors, but the violent straining efforts, which the child had kept up during the operation, brought several more tumours, as big as grapes, sufficiently low down to admit of their being cut off. Upon introducing the forefinger into the bladder, Mr. Crosse ascertained that more of the diseased structure remained behind than had been removed; and as many of the remaining tumours were attached to the bladder by a broad basis, it was deemed advisable to make no further attempts for their removal.

Notwithstanding the administration of a powerful opiate, the child continued to have violent fits of tenesmus, and could scarcely be prevented from placing himself in his usual posture, resting upon his knees and elbows, to give full effect to his exertions. At the end of four hours, Mr. Crosse placed him again upon the table to ascertain whether these efforts had caused any fresh tumours to protrude. The wound was plugged up with a coagulum, under which was a tumour as big as a nut, and of purple colour; this was easily brought down and cut away with scissors. Much of the diseased structure remained which could not be meddled with safely. After forty-four hours of incessant suffering the little patient died.

Examination of the body.—The peritoneum was free from signs of inflammation; the rectum was untouched; the ureters were much enlarged and contorted; the pelvis of each kidney so increased in size, that between

one and two ounces of urine could be contained in it. The muscular coat of the bladder was much thickened; at its fundus there was a convex prominence, covered by peritoneum, which, when cut into, proved to be a firm mass of thickened cellular substance, situated external to the muscular coat, and containing a small central cavity filled with pus. The lining or mucous membrane of the bladder, of gelatinous appearance, but loosely connected, and in folds, gave origin to the disease. From the interior part near the neck numerous tumours sprung, occupying the cavity of the bladder; one, of large size with broad basis, of firmer consistence than the rest, was situated near the termination of the left ureter; this must have been the resisting body felt on sounding. Several small detached tumours, from the size of a pea to that of a bean, were loose in the bladder: towards the neck the tumours presented a wart-like surface: but all were covered with their proper membrane continuous with the inner coat of the bladder, which was uninjured, except in three or four spots, where the tumours had been cut off with scissors.

The neck of the bladder and the prostatic portion of the urethra were much dilated, and the tumours could readily drop into this part of the canal, a fact which accounts for the fulness of the perinæum.

Cases of polypus vesicæ have been recorded also by Collison, Petet, and Corvillard. Mr. Warner relates the case of a tumour growing from the inside of the bladder: he extirpated it successfully, but in this case the tumour projected far into the urethra, and could be felt with the finger.

Dr. Tyson likewise records a case in which a number

of polypi were found in the bladder after death. They were round like grapes, filled with clear serum, and quite free in the cavity of the organ.

The rational symptoms of these benign growths are nearly, if not entirely, the same as those of malignant tumour; but upon this part of the subject it is difficult to speak with any certainty, from the confusion to which I have already alluded. Copious loss of blood more rarely attends the benign disease; irritation is more apt to extend along the urethra, and the progress of the disease is much slower in cases of fibrous or fibro-cellular polypi, &c., than when the bladder is the seat of medullary or villous cancer. Both the benign and malignant lesions are equally attended by pain in the region of the bladder, constant and painful micturition, and occasional retention of urine. But as the non-malignant tumours are much more frequently seated about the neck of the bladder than the cancerous, the pain and irritation which they excite are more often felt about that part, and more frequently give rise to retention of urine. In many of these cases, also, hæmaturia is absent, or the urine is only slightly and from time to time tinged with blood.

An examination with the sound will often enable the surgeon to detect a pedunculated tumour about the neck of the bladder, but a more complete diagnosis is generally impossible. The absence of hæmaturia, and the impossibility of detecting cancer-cells in the urine, afford strong presumptive, though no positive proof, that the tumour is of a benign nature.

Unless some fortunate accident should render the diagnosis clear, the prudent surgeon will abstain from

all operative proceedings in cases of this kind. Above all I must dissent from the advice given by a recent authority, who says, "Whenever in any manner their real character can be ascertained, the bladder should be laid open, as in the common operation of cystotomy, and the morbid growths removed with a pair of probe-pointed scissors curved on the flat."*

When the tumours are of recent date, pedunculated, and attached about the neck of the bladder, M. Civiale thinks that they may be removed or crushed between the blades of a lithotrite. He relates some cases in which the tumours were so removed with success; but I have been quite unable to discover upon what grounds M. Civiale founded his diagnosis between malignant and non-malignant tumours; and unless such a distinction can be established I should be unwilling to follow even his example.

Tubercular disease of the bladder is a rare affection. There is no important organ of the body so little liable to scrofulous disease as the urinary reservoir, and the great majority of cases on record evidently belong to the peritoneal lining of the bladder rather than to the organ itself.

The only situation in which I have met with deposit of tubercular matter in the bladder, was at the upper part, between the peritoneal and muscular coats. Generally speaking, however, the deposit takes place near the floor or sides of the organ, in the form of grey or yellowish granulations, which soften, inflame the surrounding tissues, and are converted into ulcers. The

* Gross, Practical Treatise, &c. 2d edit., p. 328.

deposit is said to take place in the mucous membrane; but analogy and the examination of some specimens would lead me to conclude that it rather occurs in the submucous tissue.

The gray and yellow granulations which precede scrofulous inflammation or ulcer, are developed underneath the arachnoid, the peritoneum, and the mucous lining of the intestinal canal. In scrofulous pyelitis the tubercular matter originally occupies the sub-mucous tissue, and it is probable that the same law holds good with respect to tubercle of the bladder.

How long the granulations or scrofulous matter may remain in a latent state it is impossible to say. When they soften, they give rise to ulceration of the mucous membrane, the ulcers being round, of a pale colour, having for their base the sub-mucous tissue, and being often covered with a tenacious cheesy secretion. The ulcers have a tendency to spread superficially, not in depth. I am not aware that they have ever given rise to perforation of the bladder. In all cases where this organ has been perforated, the disease originated in some neighbouring part, the uterus for example; and it is worthy of note that the perforation appeared due to softening and simple destruction of the walls of the bladder, not to extension of the tubercular disease to it.

The symptoms of tubercular ulcer of the bladder are not well marked; they resemble those of chronic ulceration in general, and often simulate the effects of vesical calculus. In some cases the symptoms connected with the bladder are so slight as to have escaped notice during life. The ulcers were few, and of limited extent,

while the kidneys, prostate, and several other organs, were the seat of extensive tubercular disease.

That the ulcers in the cases alluded to were of a tubercular nature does not, however, admit of positive proof; they had the appearance of scrofulous ulcers; were not surrounded by inflammation of the soft parts, and in one case the cheesy tubercular matter detached from them was found loose in the cavity of the bladder.

The ordinary symptoms which attend the disease, are pain about the neck of the bladder, with frequent and painful micturition; the urine at first contains mucus, then becomes albuminous, purulent, and is often tinged with blood as the disease advances; it is alkaline in some cases, acid in others. These symptoms, either marked by, or complicated with symptoms of diseased kidney and of tubercular affections in other parts, gradually increase until the patient sinks in a state of hectic, or is cut off by some intercurrent malady.

There are no particular signs by which tubercular ulcer of the bladder can be made out with any degree of certainty. In malignant affections we derive great assistance from the general aspect of the patient, or the co-existence of malignant disease in other parts; but in scrofulous cases, deductions of a like kind cannot be drawn without great danger of error. Tubercular disease of the bladder is rare; yet scrofulous persons often labour under affections of the bladder and urinary organs; hence we must not infer, because symptoms of vesical ulcer occur in a scrofulous person, or one affected with tubercle in other organs, that the ulcer is necessarily of a tubercular nature likewise.

Dr. Gross informs us, "that when the softening process has commenced, the peculiar matter of tubercle is discharged along with the urine," and that "when any doubt exists concerning the true nature of the purulent fluid, the microscope will enable us to determine whether or not it contains tubercular matter."*

It would be highly interesting to know on what observations the author has founded this remark; for the rational symptoms of tubercular ulcer of the bladder are, as I before observed, altogether insufficient for the diagnosis of the disease. The pain is very seldom severe at the commencement; and the constant, fixed pain of malignant disease is not observed. The discharge of blood is also less constant. It seldom takes place in any considerable quantity until near the close of the disease, and never at its commencement. Generally speaking the urine is merely tinged with blood from time to time, true hæmorrhage from the bladder being, I believe, exceedingly rare. On the other hand, the admixture of pus with the urine is a frequent symptom, which continues for a considerable time.

If the small, superficial, and well-defined ulcers of the mucous membrane of the bladder, which sometimes accompany tubercular disease of the kidney, are to be regarded as tubercular also, it would follow that the two affections not unfrequently co-exist.

Rokitansky, however, observed that "tubercle of the vesical mucous membrane is rare, and is not always found as a complication of tubercular affection of the urinary apparatus, which, as we have already seen, is

* L. c., page 314.

combined with, and results from, tuberculosis of the sexual organs."

In what proportion of cases tubercular disease of the bladder is accompanied by tubercular deposits in other organs it is not easy to determine; because in most of the cases reported the vesical ulcer has been set down as tubercular without any substantial proof of its having belonged to that class. On the other hand, we know that a tubercular condition of the lungs, at least, is rarely attended by a similar deposit in the bladder. In the numerous post-mortem examinations made by M. Louis he never met with a single example.

The treatment must be general as well as local. By the former, we endeavour to correct the tubercular tendency; by the latter, to palliate the effects of irritability of the bladder. Bloodletting and debilitating remedies of any kind are inadmissible. The ulceration does not depend on ordinary chronic inflammation, and if the patient were not affected with a still more serious disease in other organs, the vesical ulcer might perhaps heal after the elimination of the tubercular matter. Hence, in a case of this disease, we should endeavour to support the patient's strength, and relieve the irritable condition of the bladder by anodynes and other soothing measures.

CHAPTER XII.

ABNORMITIES OF THE BLADDER.

Those organs which are placed in the median line of the body are more subject than others to certain deviations from their normal development. The bladder, though so important an organ, does not escape the influence of this law. It is subject to several abnormities, some of which are irremediable, while others admit of relief by surgical means.

In some cases of congenital malformation the bladder is completely wanting. This anomaly is always attended by more or less malformation of the urinary and other organs. In the more complex examples, the kidneys and ureters are likewise absent, and the external organs of generation imperfectly developed. When the kidneys exist the ureters are likewise present, and open into the urethra, the vagina, or the rectum. The abnormal opening of the ureters does not, however, necessarily imply complete absence of the bladder, which may be imperfectly developed and in a rudimentary state.

* Tiedemann's Zeit. für Physiol., Bd. 2, s. 1.

Professor Mayer, of Bonn, has published* a very remarkable example of this anomaly which he observed in the case of a new-born child. The external organs of generation were replaced by a small pedunculated sac, filled with cellular tissue. There was no trace of an anus, the intestinal canal terminated abruptly in the descending portion of the colon. The kidneys, ureters, and bladder were completely absent, but the supra-renal capsules were twice as large as natural. There was no trace of prostate or seminal vesicles. A case somewhat similar is recorded by Dr. Gross.* Nearly the whole mass of the small intestines was contained in a tumour attached close to the umbilicus, in which they terminated. The entire colon was wanting. No trace of the bladder could be detected anywhere. Both ureters terminated in the sac which contained the intestines; the pubic bones were absent, and the anus was imperforate.

The sacculated condition of the bladder, described by some anatomists under the term bilobed, is probably rather an acquired than a congenital state, the septum being produced by elongation of the mucous membrane; but, from arrest of development at different stages of intra-uterine life, the bladder may appear to be double, or it may be fissured along the middle line.

The different organs, in fact, are double, at a very early period of fœtal existence. As development proceeds, the lateral moieties advance towards each other and at length touch on the median line; the septa gradually disappear, the walls coalesce on the middle line, and the organ acquires the unity of formation necessary for

* L. c., page 112.

the performance of its functions in a healthy and complete manner. Hence it can readily be understood that arrest of progressive development at a very early stage may make hollow organs, like the bladder, appear double; while the same circumstance, at later periods, will give rise to the existence of deficiencies or fissures in the middle line, from want of perfect union between the lateral moieties of the organ. When the original septa have coalesced to form a single wall, and this has not been removed by the progress of normal development, the bladder, which externally appears of a natural form, is found internally divided into two parts, by the persistence of the septum; and this latter always runs more or less perpendicularly along the median line.

The transverse septa occasionally observed in the bladder are produced by irregular contractions of the muscular fibres, and are not to be regarded as abnormal conditions of the organ.

In other cases, the bladder is fissured along the middle line at the upper part or through its whole body. In the former case, we have an example of bilobular bladder—in the latter, the organ appears to be double, but this is not really the fact; if the bladder were double we should find four ureters, an anomaly that has never yet been discovered after death. This complete fissure of the bladder into two nearly equal parts, is an illustration of the curious law whereby the normal structure of one class of animals is repeated in a higher class, where its existence constitutes an anomaly.

In some rare cases, the bladder has been found imperforate; in others, its cavity is divided into two distinct portions, by a septum which runs perpendicularly

or more or less obliquely; but I shall not dwell on anomalies of this kind, which admit of no interference on the part of the surgeon. Let us turn to a much more common and interesting malformation, viz., extroversion of the bladder. This anomaly depends on imperfect development, whereby the union between the lateral moieties of certain organs remains incomplete on the median line. Hence in the cases now alluded to, there is a deficiency of the walls of the bladder on the median line; and as this deficiency is also accompanied by imperfect union of the abdominal walls, we have the abnormity which is denominated fissure, or, more correctly, extroversion of the bladder. The malformation occurs much more frequently in males than in females. Of sixty-eight cases collected by Mr. Earle, sixty had occurred in males, only eight in females.

M. Geoffrey St. Hilaire found about one fourth of the cases appertaining to females. Mr. M'Whinnie states, in an interesting paper in the 'Medical Gazette,' that out of nine cases which had fallen under his observation, two only were females. Indeed, the observation of the comparative exemption of females from this malformation, had been long before pointed out by Dr. Duncan. No attempt has been made to explain why the male should be more subject than the female to this abnormity, but we should remember that it is seldom confined to the bladder alone, it extends to the genito-urinary system; and the more complex or complete a system of organs, the more is it subject to deviations from the normal type.

Extroversion of the bladder presents several varieties

of degree, depending on the amount of deficiency in the vesical or abdominal walls, and on the abnormities of other organs by which it may be accompanied. It should also be remarked that the deficiency in the anterior walls of the bladder and abdomen is attended by more or less displacement of the urinary reservoir; the posterior wall is propelled forwards, becomes everted, and presents itself in the form of a round red tumour, at the lower part of the abdomen. This anomaly may be distinguished into two forms, according to its degree. In the more simple, we have merely a deficiency of the vesical and abdominal walls; in the more complicated form, which is likewise the more frequent, the pubic bones are separated at the symphysis, and other anomalies occur which I shall presently notice.

The tumour formed by the everted bladder is characteristic, and cannot readily be mistaken for any other organ. It exists at the lower part of the abdomen, on the median line, or more commonly in front of and just above the pubes.

In this situation, it forms an oval or rounded swelling, the surface of which is red, vascular, and in most cases can be seen to be composed of mucous membrane. From the lower part of the tumour, the urine dribbles away almost constantly; and on examining the swelling at this part, we discover two small eminences, perforated by openings which are the orifices of the ureters. The tumour is often increased by coughing, straining, &c., during which a portion of the abdominal viscera may become engaged in the sac formed by the everted walls of the bladder. In some cases, on the other hand, the tumour may be partially returned into the abdominal

cavity, through the fissure between the recti muscles, by gradual and continuous manipulation.

The size of the tumour varies at different times in the same subject, but chiefly according to the patient's age, or, in other words, according to the duration of what, practically speaking, may be called his disease.

In new-born children the swelling does not project much, and rarely exceeds the size of a walnut. In the adult, as we can readily understand, the tumour gradually attains a greater volume, and many become as large as the fist, being two or three inches in its vertical and four or five inches in its transverse diameter. Although exposed for years to external influences, the mucous membrane of the everted bladder undergoes much less change than might have been supposed. At first it is somewhat tender and bleeds readily, but it soon gets accustomed to external impressions, the vascularity diminishes, the surface is covered with a coat of mucus, and in old cases the membrane may become quite smooth.

In a few rare cases, as I have said, the malformation is confined to the anterior walls of the bladder and abdomen.

In the great majority of cases, however, the abnormity is of a complex kind, involving the pubic bones and external organs of generation. These parts appear to follow the same law, under the influence of which the bladder and recti-muscles remain separate; their deviations chiefly consist in a separation of the lateral moieties, on the median line. The pubic bones, then, are separated from each other at the symphysis to the extent of several inches; the deficiency may even amount

to five inches, but during life, the vesical tumour and hernia accompanying it often prevent us from determining the state of the pelvic bones in a satisfactory manner. The extensive separation of the pelvic bones necessarily involves some anomaly of the male organs of generation, which are so peculiarly connected with them. The penis is usually in a rudimentary state; and as the urethra is not required for the emission of urine, it opens in various directions, in the male above the penis, in the female above the clitoris. Epispadias, more or less complete, usually coexists with this abnormal situation of the urethra. The testicles are often retained in the abdomen, or they may occupy an imperfect scrotum. In some cases, the external organs of generation are completely wanting, but the imperfect tegumentary sac which represents the scrotum, often contains a portion of the intestinal canal.

Extroversion of the bladder is not only less frequent in the female, but it is less apt to be attended by remarkable deviations of the genital system. The clitoris and labia are usually in a state of imperfect development, and prolapsus of the uterus is very liable to occur from the separation which exists between the pubic bones.

The records of surgery contain a great number of cases of this affection. In one of these, related by Mr. Erichsen, the penis was rudimentary, with complete epispadias : the urine, constantly distilled from the open mouth of the ureters at the lower part of the swelling, and fell during the erect posture in part upon the open groove of the urethra, which served imperfectly as a spout. In each groin was a projection which became

more marked as the growth of the body advanced, corresponding with the widely separated pubic bones. From the want of the symphysis and consequent support in front of the pelvis, there resulted considerable weakness in the part, and much awkwardness in motion. These inconveniences, as well as the general deformity, were further increased by the distance to which the thighs were thrown apart from one another. This case is particularly interesting from the fact that an account of the post-mortem examination has been published by Mr. M'Whinnie in the *Medical Gazette*, the patient having died of phthisis. "In the groin," he observes, "on each side of the malformed genito-urinary organs, is seen the prominence corresponding with the body of pubes. The general aspect of the body, as well as the signs manifested during life, showed that the period of puberty had not been retarded. Here there was no appearance of umbilical cicatrix; the recti abdominis, in the upper two-thirds of their extent, were about an inch apart; below this a triangular space was left by the divergence of each muscle to the corresponding pubic bone, which was separated from its fellow to the distance of about two inches and a half. Through this fissure the irregular nodulated mucous surface of the posterior wall of the bladder protruded; its muscular fasciculi had acquired considerable strength. The mouths of the ureters, directed towards each other, were surrounded by prominent papillæ. On looking into the pelvis, the vacuity there was very striking; the space between the anterior wall of the abdomen and the rectum, ordinarily filled by the bladder, being here entirely unoccupied.

"At the upper margin of the vesical tumour, the obliterated umbilical arteries converged to come into contact with the remains of the umbilical vein, which took a longer course than usual to reach the liver.

"The pubic bones, often connected by strong ligaments in cases where they are disjoined, which in some measure counterbalances the want of osseous union, had merely a few thin fibrous bands passing between them, quite inadequate to give fixity to the parts, or to support the viscera.

"The rudimentary penis measured about one inch and a half in length; the glands, cleft at the upper part, had appended to it below an imperfect preputial covering. The epispadias was complete; the urethra presenting a simple open groove or furrow, upon the surface of which several follicles opened. The prostate, deficient above, was of tolerable size beneath the canal. Into this part of the urethra the seminal ducts terminated as usual on each side of the verumontanum.

"The testes, though diminutive, were, as in most analogous cases, natural in structure. They had descended into a small contracted scrotum. The vasa deferentia had their proper relation to the vesiculæ seminales, which were below the natural size. The ureters, sometimes so enormously dilated, as if designed almost to compensate for the want of the proper reservoir, were quite natural. Each corpus cavernosum diverged from its fellow; and taking a more transverse direction than usual, was connected by its crus with the corresponding ischium, where it was covered by a few faint fibres of an erector muscle. Some slender elongated fibres occupied the situation of the transversus perinei.

As in many other instances, the anus was immediately behind the scrotum."

Mr. Wiblin, of Southampton, has recorded, in the *Medical Times*, an interesting case of this deformity, illustrated by a drawing, exhibiting the appearance presented upon the front surface of the abdomen. The patient, twenty-eight years of age, of robust and masculine appearance, was employed as a coal-lifter on the quay. At a very early period of his life he had been examined by several medical men, who conveyed to his relations the impression that he was an hermaphrodite; and under this appellation he had passed the latter years of his life, subjected to the most painful annoyances. His dress consisted of a very long smock-frock, but in consequence of the great inconveniences occasioned by the dress being sometimes found frozen to his person, this attire was abandoned for high leggings. The pubic bones were separated to the extent of at least three or four inches, and a distinct cartilaginous band passed across from one angle of the pubic symphysis to that of the other, and in a measure tended to compensate for the weakened condition of the parts which such a separation must necessarily produce. The rudimentary penis was about one inch-and-a-half in length, and had a perfectly formed corona glandis; the prepuce was bifid, and had the appearance of two wart-like appendages. Upon the upper surface of the organ was a groove, in which were seen numerous lacunæ, and at its base the termination of the ejaculatory ducts, on either side of the caput gallinaginis. Through the extensive triangular opening in the inferior parietes of the abdomen the posterior wall of the bladder protruded. When the

patient assumed the erect posture the swelling was about the size of a very large orange. The mucous membrane of the upper portion of the tumour was highly vascular and shining. On the inferior and lateral portions of the protrusion there existed an exceedingly sensitive and painful strawberry-like pulpy surface, and below this on either side, the external openings of the ureters, from which the urine dribbled away as fast as it became secreted. Above the parts thus described, and immediately under the apex of the triangle formed by the separation of the abdominal parietes, was a small hernial protrusion. In this case, as in those recorded by the late Mr. Earle and Mr. M'Whinnie, there was no umbilicus.

In cases of extroversion of the bladder the principal inconvenience arises from the constant dripping of the urine, which not only renders the patient uncomfortable, but may seriously interfere with his ordinary avocations. Relief may often be afforded by the application of instruments to retain the urine within the vesical cavity, and prevent the excoriation of the integuments produced by its constant dribbling away. The apparatus recommended by the late Mr. Earle may be worn with advantage. It consists of a silver bowl which covers and protects the tumour and external organs, and is retained in situ by a double truss or appropriate bandage. The collected urine flows through a funnel at its lower part into an India-rubber bottle placed between the knees. Several attempts have been made to afford relief by operative proceedings. These chiefly consist in efforts to establish a communication between the bladder and rectum, and might, perhaps, be appli-

cable to cases in which the external organs of generation do not present any remarkable deviation from the normal state.

In October, 1851, Mr. Lloyd, of St. Bartholomew's Hospital, performed an operation for the relief of extroversio vesicæ, on a healthy looking man, 30 years of age. At the lower part of the abdomen there existed an opening readily admitting two or three fingers, surrounded by a red granulating border; above this, the integuments were raised by a prominent elastic tumour formed by the fundus of the bladder. From the opening described the urine escaped constantly, and excoriated the thighs and adjacent parts of the abdomen. The penis was short, and imperfect along the upper surface, which was marked by a deep groove. The prostate existed, for the lateral lobes could be felt through the rectum, but the organ was smaller than natural. The scrotum was complete, and contained the testicles.

The patient having been rendered insensible by chloroform, and secured as in the operation of lithotomy, a long trocar armed with some threads was passed through the posterior wall of the bladder from the rectum. The seton having been detached, the instrument was withdrawn, and the two ends of the threads, one projecting from the rectum, the other from the vesical cavity, were tied in a knot. The operation was quickly and easily performed. It had been Mr. Lloyd's intention, after the passage of the urine through the rectum had been established, to close the abdominal opening by paring its edges with a sharp knife and uniting them by suture. Unfortunately, the latter

part of the operation could not be completed, for the patient died on the fifth day, severe pain, with swelling and tension of the abdomen having ensued on the second day after the operation, and the patient sunk with the ordinary symptoms of peritonitis. On examining the body it was found that the recto-vesical fold of the peritoneum descended much lower towards the neck of the bladder than it usually does; it even reached the imperfectly developed prostate. The peritoneum had been perforated; indeed there was no space uncovered by peritoneum through which any instrument could have been carried. A somewhat different operation was performed at St. Thomas's Hospital, by Mr. Simon, and with a more fortunate result. Instead of perforating the bladder from the rectum, Mr. Simon passed canulæ, armed with threads, through the openings of the ureters, and brought the threads out through the rectum. Serious constitutional disturbance ensued, but the patient struggled through, and was eventually enabled to bear the pressure of a pad in front, by means of which the opening in the abdomen was closed and all the urine forced into the rectum.

It cannot, however, be concealed, that operations of this kind, undertaken solely to relieve a patient from inconvenience and deformity, are hazardous to life; while it may be a question whether the inconvenience of passing the urine through the rectum may not be quite as great as that of discharging it through the opening in the abdomen.

In connection with this subject, allusion may be here made to a discharge of urine from the umbilicus, which may result from abnormal patency. The urachus may

sometimes remain pervious for a short distance from the bladder, or through its entire length. In such case, the patient, on attempting to expel the urine, finds that some of the fluid escapes by the umbilicus. The integuments in front of the abdomen are excoriated; the umbilicus itself is red, and presents at one spot a prominent red papilla or elevation, in the centre of which is an opening through which the urine may be occasionally discharged: a probe can be passed readily downwards in the direction of the bladder. We possess no means of effecting the closure of the urachus in cases of this kind.

Mr. Paget, of Leicester, has recorded, in the 'Transactions of the Royal Medical and Chirurgical Society,' the case of a man, 40 years of age, in whom a ring-shaped calculus formed upon a hair in the bladder, was extracted through a patent urachus at the umbilicus. The bladder being distended, Mr. Paget introduced the finger through the duct, and removed the calculus without trouble. In this case it was obvious that the bladder and the urachus formed one urinary receptacle which in shape might be compared to a curved neck cupping glass.

When the urachus remains open, a light truss with a pad of proper size may be constructed to pass round the body and press upon the umbilical opening. The patient, from whom Mr. Paget extracted the calculus, wore a girdle with a thick flannel pad to catch the jets of urine which were apt to occur when he was at work. Mr. Startin has found that great advantage may be derived to the surrounding excoriated parts by varnishing them with collodion.

Instead of solely occupying the anterior wall of the bladder, the fissure or deficiency may be seated in the posterior wall of the organ. In all such cases the anterior wall of the rectum is likewise deficient, and a kind of cloaca is formed for the common reception of urine and feces—a malformation representing the normal structure in certain animals. It is almost unnecessary to say that such an abnormity does not admit of operative interference. The case resembles, in one respect, recto-vesical fistula, but the loss of substance is too great to be remedied by plastic surgery. All that we can do is to devise means for alleviating the effects of the malformation.

CHAPTER XIII.

LACERATION OF THE BLADDER.

Although so carefully protected from the effects of external injuries by the strong case of the pelvis, the bladder occasionally suffers from external violence. It may also be injured in a different manner, by pressure from within outwards, as when the organ gives way from over distension of its cavity. The former accident I would call laceration, the latter, rupture of the bladder. In the one case, the injury is sudden, and the tissues adjacent to the lacerated portion have previously undergone no change; in the other case, the determining cause of the rupture is more or less slow in its operation, and the vesical tissues have probably undergone some change at the point which gives way under pressure. Gun-shot or penetrating wounds of the bladder, and other injuries of a similar kind, belong to the general domain of surgery, and will not be noticed in the present chapter.

Laceration of the bladder, as we can readily conceive, only occurs in consequence of some great external violence, the bladder being at the time full of urine.

Sudden blows, or the pressure of a heavy weight on the lower part of the abdomen, are the most frequent causes of the accident. I have known it to occur during a struggle between two powerful men, after drinking; the one fell with his knee on the abdomen of the other, and laceration of the bladder, followed by fatal peritonitis, rapidly ensued. I have also known the bladder to be lacerated by a fall from the top of a coach. A gentleman was riding on the box of his carriage with his coachman, when the vehicle was upset; the coachman fell on him, and the master's bladder was lacerated. The patient lived from the Sunday on which the accident had occurred, until the following Wednesday.

In a few cases the bladder gives way, not under direct violence, but from general concussion of the frame, as when a man falls on his feet from a height. Mr. Cusack, of Dublin, has related a case of this kind.*

The part of the bladder which gives way under sudden violence, is generally that portion of the posterior wall which is covered by peritoneum. Dr. Harrison, explains this fact in the following manner: "The several tunics of the bladder allow of considerable distension; but least of all, the peritoneal; when, therefore, the bladder becomes fully distended; and is subjected to any sudden or violent compressing force, this tunic, which is then tense, and comparatively unyielding, will crack, while the subjacent tunics, which are connected to it, will be torn along with it; whereas in other situations, where cellular tissue occupies the place of serous

* Dublin Hospital Reports, vol. ii, p. 310.

membrane, the coats of the bladder will yield considerably before they give way, or admit of laceration.*

The extent and appearances of the laceration vary in almost every case. It is sometimes a mere fissure; sometimes it extends to several inches, the edges of the lacerated surface being ragged and everted. The appearances will also vary somewhat, according as the injury may have occurred in the peritoneal or extra-peritoneal portions of the bladder; but when the patient has survived for a few days, the inflammation which supervenes will mask the appearances belonging to the original lesion.

Laceration and rupture of the blader occur more frequently in males than in females; in adults than in children. Dr. Stephen Smith, of New York, who has published a valuable monograph on this subject,† gives an analysis of seventy-eight cases, reported by various authorities. Of the seventy-eight patients, sixty-seven were males, and eleven females; only three of the patients were under ten years of age. Dr. Harrison, ascribes the greater rarity of the accident in females to the greater size of the pelvis, the cavity of which is not so extensively occupied by the bladder, when this organ is full of urine.‡ We should also bear in mind, that in five cases out of six, the accident arises from external violence, to which women are much less exposed than men.

The comparative exemption of children from giving

* Dublin Journal of Medical Science, vol. ix, p. 371.

† New York Journal of Medicine and Surgery, new series, vol. vi, p. 374.

‡ L. c., p. 372.

way of the bladder, is ascribed, by Dr. Harrison, to their rarely suffering the organ to become much distended with urine; also, in part, to the smaller size of the sacral promontory, and to the fact that the bladder when full, lies, in early life, more in the abdomen.

Rupture of the bladder is a much less frequent accident than laceration, and occurs under very different circumstances. The one is the result of sudden external violence, and commonly occupies that part which is covered by peritoneum. Rupture of the bladder, on the other hand, is too often the result of neglect; is preceded probably by softening or some other change in the vesical walls, and is more commonly seated near the neck, or at the posterior wall of the bladder, below the reflected fold of peritoneum.

Retention of urine within the vesical cavity is the determining cause of rupture in most of these cases. The bladder becomes gradually distended, until its walls get thin and weakened; ulceration and softening ensue at a particular point, and the bladder either sloughs, or the urine is forced through the softened walls, to be diffused into the cellular tissue of the pelvis, or escape by some of the natural openings. In some cases the bladder is ruptured by the pressure of the child's head during parturition; or it may be lacerated by the use of instruments.

The retention of urine, which leads to rupture of the bladder, may depend on several causes. Impermeable stricture of the urethra, enlargement of the prostate, any lesion, in a word, which effectually opposes the discharge of urine, may lead to retention, over-distension of the bladder, and rupture. Sir E. Home and Sir B. Brodie

have recorded cases of rupture of the bladder from stricture. M. Amusat met with a case in which the accident arose from enlargement of the prostate. It may even take place without the existence of a mechanical obstacle. Thus, Hauff relates the case of a person who was seized at the dinner-table, after having drank a quantity of wine, with violent pain in the abdomen; the abdomen, however, was not tense, nor was there any tumefaction over the region of the bladder; a small quantity of urine only was discharged through the urethra. The patient died in four days, with symptoms of violent peritonitis; the bladder was small, thickened, and perforated; urine was effused into the cavity of the abdomen.*

In cases of this kind, the peritoneal cavity, or the cellular tissue of the pelvis, according to the seat of the perforation, are found in a highly inflamed state. Near the fundus of the bladder there are one or more perforations, with black and ragged edges; while the viscus is found relaxed and empty, and the abdomen or pelvic tissues contain a quantity of urine.

After typhus fever and some other debilitating affections, perforation of the bladder occasionally occurs, an irregular opening with ragged edges being after death generally found in the posterior part of the organ through which the urine has escaped. In such a case there must have been great neglect on the part of the attendants, in allowing the completely paralysed bladder to become distended. It is a good plan for the surgeon, if called in upon these occasions, to assure himself of the condi-

* Civiale, Traité Pratique, t. iii, p. 260.

tion of the bladder, by placing his hand upon the hypogastric region; while he should also always inquire what quantity of urine has been voided during the preceding twenty-four hours. The introduction of the catheter is of course easy, and the instrument should be regularly used night and morning.

Rupture of the bladder occasionally takes place during parturition. The mechanism of the accident in such cases is easily understood.

Retention of the urine arises in consequence either of neglect or of external pressure; the head of the child compresses the distended organ: and rupture of its walls may ensue directly in consequence of this pressure or from inflammation and sloughing. In a case of this kind, related by Mr. Hey,* the symptoms attendant on retention of the urine did not take place till the second day. The patient who was thirsty and vomited, had frequent desire to void urine, which she did very suddenly, but not in greater quantity than a tea-spoonful at a time. The pulse was quick, the belly swelled, and pressure gave her pain. She died about the eighth day, and the bladder was found to be ruptured at its upper part. A case is also related by Mr. Bedingfield,† in which the bladder seems to have given way during a very easy labour of only two hours' duration. The patient died of peritoneal inflammation.

The following case was related at the Medical Society of London, by Mr. Hird:—A bricklayer, after drinking with some friends at Kensington, was knocked down and run over by a cab; he was taken to the house of a

* Medical Observ. and Inquir., vol. iv.

† Lancet, June, 1837.

surgeon in Lambeth, who dressed a slight wound on the head. After this he walked home to Pimlico, a distance of nearly two miles, and about three hours after, at the request of the gentleman who ran over him, Mr. Hird saw the patient. He found him in bed, and complaining of severe pain in the hypogastric region; but having drunk to excess, the patient was unable to give an account of his sensations at the time of the accident. He had vomited two or three times, and had felt great desire to make water; but not more than two or three table-spoonsful, slightly tinged with blood, had dribbled away. He was cold, and occasionally shivered, and was covered with a clammy perspiration. The pulse was full, and 120. The abdomen was distended, but did not evince, on examination, the circumscribed form observable in cases of distended bladder from retention. The patient died three days afterwards. On opening the abdomen the bladder was found small and contracted, with an oblique fissure, an inch and a half long, in the posterior inferior part, and opening into the peritoneal cavity. The mucous membrane of the bladder was healthy and slightly everted at the aperture.

I am indebted to Dr. Peacock for the following interesting case:—A horse-breaker, aged thirty-eight, while driving a restive horse in a gig, was thrown out, and the vehicle passed over the lower part of his abdomen. He was immediately carried to the Chester Infirmary; no marks of injury were displayed externally, and after rallying from the effects of the fall, he seemed pretty well. The following afternoon, however, it was ascertained that he had not made water since the occurrence of the accident, and the catheter being introduced,

about eight ounces of fluid, deeply tinged with blood, were withdrawn. He then also began to experience considerable pain in the hypogastric region, and there was much tenderness on pressure, for which he was bled and leeched. The catheter was required to be introduced at intervals for several days, after which he regained the power of voiding water; the urine assumed its natural appearance, and the febrile symptoms, to a considerable extent, subsided. He, however, declined in strength, typhoid symptoms came on, and he sank on the 16th of January, 1841, or on the seventeenth day from the receipt of the injury; two days before his death he again had retention of urine, and the fluid removed by the catheter was very dark coloured and fetid.

The body was examined twenty-four hours after death. No fluid was contained in the peritoneal cavity. The omentum was firmly attached by old adhesions, to the abdominal parietes in front, and to the intestines below. The small intestines were also firmly united together, and had become adherent to the edges of the pelvic cavity. The bladder displayed, at the posterior part of the fundus, a lacerated opening capable of admitting of the passage of two fingers, which led into a cavity situated posteriorly and inferiorly to it, and which was bounded by the adherent intestines above, by the sides of the pelvic cavity laterally, and by the rectum behind and below. The cavity contained fetid urine, mixed with shreds of lymph and gangrenous cellular tissue. On the side where it was bounded by the rectum there was an ulcerated aperture, by which it had opened into the rectum. This aperture was

nearly the size of half-a-crown, and was situated at about four inches from the verge of the anus. The adhesions by which the omentum and intestines were united together and to the edges of the pelvic cavity, were evidently of old date, and long anterior to the accident. The coats of the bladder were much thickened, and its lining membrane was covered with tough mucus mixed with lymph. The kidneys were much enlarged; they were easily deprived of the proper tunic, and the surface exposed was of a deep purple colour. Their texture was infiltrated with small purulent deposits, and the organs were generally very soft and readily tearable.

The prolongation of life in this case was evidently due to the peculiar situation of the laceration of the bladder, in consequence of which the urine had escaped into the vesico-rectal cellular tissue. The extension of inflammation to the peritoneum had also been prevented by the old adhesions between the omentum and intestines in the hypogastric region.

In the 'Transactions of the Pathological Society,' Mr. Prescott Hewett has related ten cases of laceration of the bladder. In two of these ten cases there was no injury of the bones; in eight the pelvis was extensively fractured. In two cases the bladder was ruptured into the peritoneum (one being with fracture of the pelvis, the other without). In eight cases the rupture was into the cellular tissue of the pelvis; in these eight cases the bladder was ruptured in its fore-part in five, in its lateral parts in two, at its neck in one.

"Both the cases into the peritoneum were most interesting: the one from its rarity, the injury having

occurred in a woman, of which there are very few cases indeed placed on record; the other from there being so small a quantity of fluid found in the peritoneum, merely an ounce, and yet the rent in the bladder was large enough to admit of the passage of the first two fingers, as well as there being no trace of inflammatory action about the serous membrane.

"The variety of points at which urine extravasated into the subperitoneal cellular tissue might show itself, was also well illustrated in some of these cases. In one, the patient living twenty-three days, large abscesses made their appearance above the pubes and in both iliac fossæ. In another, in addition to these regions, the scrotum and perinæum became extensively infiltrated. In a third, the right side of the scrotum was the part principally affected, the urine having passed through the right internal ring and down the inguinal canal. In a fourth, the upper part of both thighs was affected, the urine having passed through the obturator foramina.

"Lastly, the reparative efforts sometimes made by nature in accidents of this kind were also well shown. In a patient who lived five days after the accident, the cellular tissue in the immediate neighbourhood was condensed by lymph, forming a species of pouch connected with the margins of the rupture. In another case, living twenty-three days after the injury, the surrounding cellular tissue was so condensed, and so firmly attached to the margins of the rupture, except at a small point, that the secondary cavity thus formed presented the appearance of a sacculus of the bladder which had given way."

Patients, as Mr. Hewett has shown, may survive this accident for a considerable time, or they may even recover altogether. Of the seventy-eight cases analysed by Dr. Smith, five terminated favorably.

Mr. Syme* has published a very interesting case of rupture of the bladder from violence, which terminated in recovery. The patient, a youth 17 years of age, received a violent blow on the lower part of the abdomen, in attempting to leap over a wooden paling. He immediately experienced intense pain, and a feeling as if his bowels had protruded; as soon as he was brought home a catheter was introduced, and four ounces of bloody urine were drawn off. The patient complained of severe pain in the belly, which was distended; his look was sunken, anxious, and he presented all the usual signs of ruptured bladder. On the fourth day after the accident the abdomen had become much swollen, with evident signs of fluctuation, and it was thought that an incision of the linea alba, above the pubes, might be of use. This was made, and a quantity of urine escaped through the wound, the patient experiencing much relief from its discharge. Two days afterwards, the urine ceased to flow through the wound, and unfavorable symptoms set in. The incision was therefore enlarged with a bistoury, and from this time no dangerous symptoms appeared. On the 20th, Mr. Syme, while removing a portion of sloughy membrane, passed his finger into the bladder through a rent more than an inch long on the pubic side of the reflexion of the peritoneum.

* Pathol. and Pract. of Surgery, p. 332.

On the thirtieth day, seven ounces of urine came away through the urethra, and in a fortnight afterwards the patient was well. The fortunate result in this case evidently depended on the rupture having occurred in a part of the bladder not lined by peritoneum.

Another remarkable case, which occurred in the practice of Dupuytren, illustrates the manner in which nature makes an effort to heal the wound. A powerful man, 30 years of age, after having drank a considerable quantity of wine, became engaged in a quarrel with his neighbour, and received a violent kick on the lower part of the abdomen. He instantly experienced most severe pain in the part, and was carried to the Hotel Dieu. Blood was drawn from the arm, and leeches were applied over the pubes, but the febrile symptoms were not relieved. Although the bladder did not appear to be distended, M. Dupuytren introduced a catheter, and drew off a small quantity of turbid reddish urine. While directing the point of the catheter towards different parts of the bladder, Dupuytren remarked that the instrument penetrated much further than it should at a particular point near the upper and anterior wall. On pushing the instrument it penetrated still further, and then more urine came away. It was now suspected that effusion of urine had taken place into the abdominal cavity. The patient died on the seventh day.

On examining the abdomen, some strong cellular adhesions were found between the walls of the abdomen, the sides of the bladder, and the viscera contained in the pelvis. These adhesions formed a kind of sac behind the bladder, containing a turbid fluid which had

an urinous smell and was mixed with shreds of lymph. In the posterior wall of the bladder was found a lacerated opening about two inches long. The abdominal viscera were not inflamed, but a few points of the mucous membrane in the small intestines and stomach were slightly injected. M. Dupuytren was much struck by the admirable manner in which nature had separated the diseased parts from the cavity of the abdomen.*

The symptoms of laceration and rupture of the bladder vary much in kind and intensity in different cases. The early symptoms are probably connected with the accident itself; those which set in later depend on the inflammation excited by the effused urine. In some cases the patient seems to experienee little inconvenience from the serious injury inflicted on him. The symptoms proper to laceration are absent, and the injury may not be suspected until inflammation begins to set in; more commonly, however, the patient experiences severe pain at the lower part of the abdomen immediately after the accident, and then exhibits the ordinary signs of violent shock. He becomes weak and faint; the pulse is feeble, the countenance anxious, the extremities cold; he is unable to expel the urine, and sometimes loses all desire to make the attempt. The little urine that escapes or may be drawn off by the catheter is tinged with blood; nausea or vomiting next ensue; the patient becomes restless, and the abdomen is somewhat tender to the touch, or may be prominent just above the pubes. These are the precursory signs of inflammation, which sets in at a very uncertain period

* Arch. de Méd., new series, t. v, p. 294.

after the accident; sometimes after the lapse of several days.

This inflammation and the symptoms which accompany it will be modified according as the injury has taken place in the part of the bladder covered or not by peritoneum; in other words, according as the urine may be effused into the peritoneal cavity or into the cellular tissue of the pelvis.

The occurrence of peritonitis is indicated by the febrile reaction, and the condition of the abdomen: as the symptoms of collapse from shock pass away, or after a certain interval of ease, the patient begins to complain of uneasiness and pain in the lower part of the abdomen; these quickly spread until the whole belly becomes extremely tender to the touch. At first the lower part of the abdomen is somewhat full; it now becomes tympanitic, the febrile symptoms keep pace with the local signs, delirium ensues; the well-known symptoms, in a word, of peritonitis, are developed, and the patient dies.

When the urine has been effused into the cellular tissue of the pelvis, the symptoms and progress of the case very much resemble those in certain fatal cases of lithotomy. The shock produced by the accident is the same, but the inflammatory symptoms which supervene are not so well marked; there is more prostration, and as the peritoneum is involved in a secondary manner only, the symptoms of peritonitis occur at a later period, or may be absent altogether. This chiefly happens when the bladder has given way low down, at the back part; if the lateration has taken place above and in front the peritoneum is more rapidly affected.

The diagnosis of laceration of the bladder is seldom difficult. The history of the case and the condition of the patient clearly point to the nature of the accident. It arises from external violence or general concussion acting on a full bladder; and when these causes are immediately followed by severe pain in the region of the bladder, with constant desire but inability to pass water, and the peculiar symptoms of sinking which indicate a violent shock to the system, we have a train of circumstances which show not only that some viscus has been ruptured, but that the viscus is the bladder. Other symptoms will also assist us in doubtful cases. There may be a tumour at the lower part of the abdomen; but as the swelling depends on effused urine, it is rather a diffused tension, unlike the circumscribed tumour resulting from retention of urine. On introducing a catheter, a small quantity of bloody urine or even blood may come away; and on observing the manner in which the urine flows it will be seen that it comes away irregularly and in small quantities at a time, not like the natural flow from an organ desirous to relieve itself of its contents. As occurred in Baron Dupuytren's case, the end of the catheter may become engaged between the edges of the opening, and the diagnosis is thus rendered certain; but such a chance cannot be reckoned on. In cases of rupture we may also acquire an additional sign of great value from the manner in which the effused urine makes its way into the cellular tissue above the pubes or at the floor of the pelvis, &c.

The treatment of the injury which I have now described must be conducted on the general principles

of surgery. The indications are simple and sufficiently manifest; a highly irritating fluid has been effused into the cavity of the peritoneum or the cellular tissue which envelopes the bladder at those points uncovered by serous membrane; we cannot withdraw the effused urine from the cavity of the abdomen, nor in the first instance from the pelvic cellular tissue, while the irritating fluid is sure to produce violent inflammation of the textures with which it comes in contact. Our first object, then, must be to obviate the risk of further effusion by keeping the bladder as empty as possible; our next will be to combat any inflammatory action that may arise; and in cases of pelvic infiltration our final object will be to limit the effect of the effused fluid by giving egress to it whenever circumstances will permit. The means by which these several indications may be fulfilled are so obvious that it seems almost unnecessary to dwell on them. The patient should be kept perfectly quiet in the recumbent posture, and the depressing effects of the shock obviated by the usual remedies. To prevent any accumulation of fluid in the bladder, and the consequent risk of further extravasation, the catheter should be passed frequently, or, if possible, a full-sized catheter should be kept constantly in the bladder.

As soon as the symptoms of shock have been relieved, the antiphlogistic treatment should be commenced, if the patient be young or strong, and vigorously pursued as the symptoms of peritonitis become developed. No treatment can be of any avail, if the urine has been effused into the cavity of the abdomen; but the effusion may be extra-peritoneal, and the inflammation of the

serous membrane may be secondary. Under these circumstances, the serous inflammation may be, perhaps, confined to that portion of the peritoneum which adjoins the mass of effused urine, as was seen in the case quoted from Dupuytren, and there may be a faint chance of saving the patient's life. General bloodletting, the application of leeches to the abdomen, and the administration of calomel with opium, are the most powerful means of arresting peritoneal inflammation; but, if it be evident that the effusion has taken place into the extra-peritoneal cellular tissue, we must be cautious how we push debilitating measures to excess. The ill-conditioned inflammation, caused by the contact of urine with cellular tissue, is little amenable to bloodletting or any internal remedies; on the other hand, every means must be employed to prevent extension of the inflammatory action to the peritoneum, or to limit its progress when it does ensue.

The treatment in cases of this kind,—that is, when the urine has been effused into the cellular tissue, should, I am convinced, be the same as that adopted for infiltration of the urine after the lateral operation for stone. The two cases are nearly identical, the only difference, so far as the urinary organs are concerned, being that in one case we have a lacerated, in the other an incised wound of the bladder. Hence, while the bladder is kept empty by the introduction of the catheter, the signs of urinary infiltration should be carefully watched. The urine may make its way above the pubes, and become infiltrated beneath the abdominal muscles, but more frequently it occupies the cul-de-sac, comprised between the peritoneum above, the rectum

and bladder on the sides, and the perinæum inferiorly. From the original source it may pass in various directions as the cases of Mr. Hewett show,—into the iliac fossæ, the scrotum, or even to the thighs, through the obturator foramina. An important point will be to discover the presence of infiltrated urine at the very earliest period possible, and then to provide for its evacuation by free incisions; a perusal of Mr. Syme's valuable case will at once show the importance of this precept. Harrison has even proposed that an incision should be made, with a curved bistoury or a trocar, through the rectum, into the cul-de-sac already spoken of.

This method is a partial application of the recto-vesical operation for stone. Dr. Walker, of Boston, has carried the notion further, and performed with success, the lateral operation in a case of lacerated bladder.

The injury, which occurred in a young man, twenty-three years of age, was accompanied by fracture of the pelvic bones; the laceration was supposed to occupy the anterior wall of the bladder. Although the patient was greatly depressed at the time of the operation, he made a rapid and complete recovery.*

* Gross, l. c., p. 146.

CHAPTER XIV.

FISTULÆ OF THE BLADDER.

I HAVE shown, in the preceding chapter, that laceration or rupture of the bladder is an exceedingly fatal accident. The danger, however, does not arise so much from the injury inflicted on the bladder itself as from the inflammation produced by the extravasated urine, and hence we find that, whenever the urine has a free outlet through any of the natural channels, the dangerous disease is converted into a distressing infirmity.

The injury, for example, may be of such a kind that an abnormal communication is established between the bladder on the one side, and the vagina, uterus, or rectum on the other. When the urine continues to flow through this abnormal opening, we term the disease a vesical fistula, and we add the words vaginal, uterine, rectal, &c., to designate the channels through which the urine is discharged.

Vesico-vaginal fistula is an unnatural communication between the bladder and the vagina, through which the whole or a portion of the urine escapes.

The causes may be either injury or disease, the former giving rise to laceration of the walls of the vagina and

bladder; the latter to ulceration or sloughing of the same parts. These two forms of vesico-vaginal fistula have not, I think, been sufficiently distinguished by writers, yet they differ in some particulars which have a practical bearing. In traumatic fistula, the discharge of urine through the vagina takes place immediately after the receipt of the accident; the loss of substance is seldom great; the edges of the rent are in a more favorable condition for union, and the prospect of cure is, therefore, more hopeful. In cases of fistula from disease or pressure, the unnatural communication is established in a more gradual manner, the loss of substance is often extensive; the tissues immediately adjacent to the fistulous opening, are more or less indurated; and if the accident has arisen from pressure during parturition, the discharge of urine through the vagina does not take place until three or four days after delivery, when the slough has become detached.

By far the most common cause of vesico-vaginal fistula is the pressure of the child's head on a distended bladder during protracted labour. The manner in which the accident is produced can be readily understood: urine is allowed to collect in the bladder through neglect, pressure gives rise to sloughing of the soft parts, the slough is detached, and the fistulous communication is established. Another, though less frequent cause, is laceration of the vagina and bladder by the use of instruments during difficult labour. If the forceps be applied while the bladder is full, the action of the instrument may produce laceration of the soft parts. In the great majority of cases which are not connected with parturition the accident arises from ulcerative perforation. The

ulcer, in such cases, may be produced by the irritation of a foreign body, as a pessary acting from the side of the vagina, or a calculus acting from the bladder; or simple ulceration may destroy the septum and open a communication between the reservoir and the canal.

Unlike most other injuries of the genito-urinary system this accident is marked by a single and characteristic symptom—the passage of urine through the vagina. This occurs as soon as the communication is established—after laceration, immediately; after sloughing, in a few days, as soon as the slough is separated. The inconvenience resulting from incontinence of urine, and the troublesome excoriations produced in the neighbouring parts are the chief effects of the accident; but they are sufficient in many cases to render life miserable. When the orifice is large, a portion of the bladder may be everted through it; or the constant irritation may excite inflammation of the mucous membrane of the vagina, in consequence of which the vagina has been found much contracted by firm bands extending across it in various directions.

Although the discharge of urine through the vagina is a sufficient proof of the nature of the disease, we should in all cases have recourse to an examination of the parts.

It is important to determine the exact situation, size, and other conditions of the fistulous opening, and hence the parts should be carefully explored with the finger, catheter, and speculum. By passing a catheter into the bladder, and a finger into the vagina, the existence of the fistulous opening can, in most cases, be

ascertained without any difficulty. Should the orifice be small, a fine probe must be employed instead of the catheter. Having proceeded so far, the surgeon's next care will be to make a methodical examination of the parts with the speculum. The patient is placed on her hands and knees, a bi-valved speculum is introduced, and the inner surface of the vagina examined throughout its whole extent. The exact seat, size, and appearance of the fistula, are thus determined in a satisfactory manner.

It is not surprising that the several conditions of the abnormal opening should vary greatly in different cases, when we reflect on the various causes by which the accident may be produced. Thus, laceration by instruments, or sloughing from pressure, may destroy the soft parts at any point, and to almost any extent, between the os uteri and the external meatus. In some cases, the destruction of soft parts is extensive, and the fistulous opening will admit several fingers or even be larger still; in other cases it is small and round, to be felt only as a slight depression with the end of the finger. In this case, it seems probable that the form and size of the opening depend either on efforts which have been made to close it, or on the healing powers of nature. Of the direction which the fistulous communication may take nothing certain can be affirmed; it is often transverse; or it may run longitudinally, towards the neck of the uterus, which indeed may have been lacerated as well as the vagina. In other cases it presents various degrees of obliquity. The aperture may be seated close to the neck of the uterus, or near the meatus; but for the most part it is found about an inch or an inch and a half above the orifice of the urethra.

The appearance of the fistulous opening will vary according as it has been produced by laceration or sloughing; and likewise according to the time at which it may be examined, whether at a short or remote period after the accident. The practical point to notice, however, is the condition of the edges, and of the tissues in the immediate vicinity. In old cases, the edges are frequently callous or turned inwards towards the bladder, and the induration extends some way into the surrounding tissues.

The prognosis of vesico-vaginal fistula is unfavorable. Great relief may be obtained by timely and scientific treatment, but a complete cure can only be expected in a few cases and under favorable circumstances. Much will depend on the seat and size of the opening: when of moderate extent, and seated near the orifice of the vagina; when of traumatic origin, recent date, and not accompanied by any considerable change in the adjacent tissues or surrounding parts, the fistulous opening presents the most favorable conditions for cure. Under opposite circumstances, an attempt may be made to afford relief, but the result must be considered doubtful, and the cure is seldom perfect. It has been stated, on good authority, that, "out of the whole of the cases treated in the London hospitals during the last three years, complete closure of the fistula was obtained in two only; in all the rest, however, more or less benefit was obtained, and in not a few the patient was, to a very great extent, relieved from her distressing symptoms."*

The treatment of vesico-vaginal fistula is either pallia-

* Medical Times, Sept. 13th, 1856, p. 265.

tive or operative. The supposed impossibility of closing an opening through which the urine constantly passes, long deterred surgeons from attempting any other than a palliative mode of treatment. This is generally ineffectual, and whenever circumstances will permit, an operation should be performed at the earliest possible period; but delay may often be unavoidable; the necessary instruments may not be at hand, or it may be requisite to remove the patient from a distant part.

In the palliative treatment two objects are kept in view: the accumulation of urine in the bladder is prevented by the constant use of the catheter, and an attempt is made to close the fistulous opening mechanically, by the introduction of a solid plug into the vagina. For drawing off the urine, Desault employed a large elastic catheter, fixed to an apparatus resembling a truss, by means of a moveable silver plate, provided with an aperture for the removal of the catheter; the vaginal plug was formed of a linen tent or a sort of glove-finger, stuffed with lint and smeared over with wax; the plug was applied rather with the object of pushing up the anterior edge of the opening against the posterior, than of merely blocking up the orifice; hence it was only applicable to transverse fistulæ.

The linen plug of Desault has been replaced by various contrivances intended to close the unnatural opening more or less completely. Thus, some practitioners recommend pieces of sponge, others elastic pessaries of various materials, hollow resinous cylinders, inflated bladders, &c.; a good plug may be readily made with a piece of dry sponge inclosed in a cylindrical

bladder; on moistening the sponge it expands and exercises a considerable degree of pressure.

This mode of treatment is seldom effectual; unless the plug be capacious, it produces little effect, and when large, it excites irritation. An apparatus may, however, be sometimes applied for the purpose, not of closing the orifice, but of alleviating the effects of incontinence of urine. Mr. Barnes, of Exeter, employed in one case an elongated caoutchouc bottle, which, when placed in the vagina, presented an opening corresponding to the fistula. This opening was occupied by a piece of sponge, which conducted the urine into the bottle. The patient herself removed and emptied the bottle three or four times a day, and experienced much comfort from its use.*

A piece of sponge was employed for the same purpose in a case which had resisted all attempts to effect a cure;† and Dzondi describes various urinary receptacles which may be had recourse to.

The radical cure of this fistula may sometimes be effected by the use of caustics or the cautery; by suture, or by plastic operations.

The caustic generally preferred is the nitrate of silver. In using the actual or potential cautery, the patient should be placed as in the operation for stone. A bivalved speculum is then introduced, and the fistulous orifice brought into view. If we have recourse to caustic, the nitrate of silver stick should be fixed at right angles to a porte-caustique, and the whole of the

* Medico-Chir. Trans., vol. vi, p. 582.

† Trans. of the Prov. Med. and Surg. Assoc., vol. i, p. 542.

free edges of the opening touched with it. The vagina is then plugged with dry lint, and a catheter is introduced having attached to it an elastic bag to receive the urine.

Dupuytren, Delpech, and many other surgeons, prefer the actual cautery to caustics. Dr. Kennedy, also, has related some interesting cases in which this method was employed with benefit.* Its application is simple, and attended with inconsiderable pain to the patient.

The object is to stimulate the edges of the opening, and promote contraction of the wound, not to produce destruction of the parts. The number of applications will depend on the effect produced by each. Generally speaking, the slough will not be thrown off, and the contractile effects of a cauterization will not be over before two or three weeks. We must allow time for the contraction to take place. Hence if, on examining the wound in nine or ten days, it be seen perceptibly contracted in all directions, a second application should be made and renewed until the opening is entirely closed.

Contraction, after the use of the actual cautery, sometimes goes on for months. Delpech, who was a great advocate for the employment of the actual cautery, recommends the vaginal border of the opening only to be touched; and Velpeau, though giving a general preference to the nitrate of silver, still thinks that in cases of long standing, with loss of substance and callous edges, the actual cautery will be best, as acting more rapidly and with greater energy. It is hardly necessary

* Dublin Med. Journal, vol. ii.

to mention that the method by caustic or cautery is confined to cases where the loss of substance is not considerable; even then a long time may be required, and the cure be imperfect.

Dr. Payen relates a case in which the use of the actual cautery was repeated several times, at intervals of two, three, and six months, until the opening was all but closed up.*

The actual or potential cautery, then, may be employed with benefit under certain circumstances; it would even appear that the opening has closed spontaneously;† but I cannot say, from my own experience, that I have ever known a case of spontaneous cure when the communication is once established. The constant passage of the urine constitutes a serious obstacle to its ever closing without surgical interference; and when a case comes before me in which there exists even a simple fissure, I always recommend the performance of the operation of paring the edges and uniting them by some kind of suture, as soon as possible, before the parts have become accustomed to their altered state; before, too, the edges of the fissure have grown hard and callous. The chance of success is, under these circumstances, far greater than when months have been allowed to pass in attempts which always proved unavailing.

For my own part, I am convinced that with the assistance of chloroform, the anæsthetic properties of which place the patient in a condition of insensibility which

* London and Edinb. Month. Jour., Jan. 1842.

† Blundell's Lectures, Lancet, No. 222, p. 333.

materially aids the surgeon in the performance of this tedious and difficult operation, many patients may be cured of a calamity which otherwise renders life insupportable. No suffering is too severe, no peril too great, for a woman anxious again to be placed in a condition of health and comfort. The existence of a vesico-vaginal fistula renders life miserable; the vagina, the labia, and the thighs, are excoriated from being constantly bathed in urine, the clothes are ever wet, and the patient is excluded from society, seldom enjoying a moment's ease, and deprived of all comfort.

The most effectual method of cure in cases of vesico-vaginal fistula is that by suture, the edges of the opening having been previously pared off in order to ensure their more speedy and complete union. This operation, proposed by Roonhuysen, about the middle of the seventeenth century, has been occasionally performed with the most complete success even under unfavorable circumstances.

The operation is often difficult; it requires special instruments, great patience, and a practised hand; and hence innumerable efforts have been made either to simplify it or to overcome its difficulties. The operation consists of two parts, paring the edges of the opening and keeping them together by various contrivances. Different kinds of instruments have been used to overcome the difficulties of the operation, which are in truth great. The surgeon has often but a narrow space to work in, and this is sometimes rendered still smaller by preternatural contractions or firmly cicatrized bands.

The unresisting, elastic, and exquisitely sensitive surface cannot be seized readily by any instrument how-

ever sharp. "Even when these difficulties have been surmounted," says Mr. Earle, "by perseverance and a modification of the various instruments, such is the influence exercised on the pelvic viscera by the slightest movements of the viscera of the abdomen, and by the action of the abdominal muscles and the diaphragm, that the adaptation of the denuded surface is often frustrated, and the sutures even forcibly torn away by a single effort to cough or sneeze."

Cauterization cannot be expected to produce complete closure of the opening, unless it be of moderate size; hence, whenever it is possible to get at the fistula, when the latter is not so large as to exclude all hope of relief, and when the bladder is not considerably everted, we should remove the callous edges and attempt to unite the wound by sutures.

Lallemand destroyed the edges of the wound with nitrate of silver, and when the superficial sloughs came away, endeavoured to keep the edges together by a peculiar kind of hook. The peculiarity of his method consisted in the circumstance that he operated on the vesical side of the fistula, not on the vaginal. His first operation was performed in 1825. The accident had been produced by a difficult labour; the fistula was about half an inch long, transverse, and seated fourteen lines beyond the meatus urinarius. Having removed the edges by a few applications of the nitrate of silver, Lallemand applied his instrument, which consisted of a silver catheter, four inches long, in which was concealed a stilet, bifurcated at the extremity, and there terminating in two short hooks. The other end of the stilet was connected with a screw, by turning which the hooks

could be forced through the soft parts or drawn within the catheter. Round the catheter was a fine spiral spring, and the external spiral was attached to a silver plate which had its *point d'appui* on the pubes. In this way, when the hooks were forced by the screw through the posterior edges of the transverse fissure, they tended to bring them into contact with the anterior border, because the spiral spring, acting on the hooks, and having its *point d'appui* at the pubes, tended to bring together the movable and fixed points.

The action of the plate on the meatus was also supposed to push the anterior edge of the wound towards the posterior. In this case a complete cure was obtained, and likewise in another, operated on in 1833. Here a single application of the instrument for five days was sufficient to produce adhesion, as in cases of hare-lip.

Baron Dupuytren modified this method in the following manner. He employed a large female catheter, furnished at its sides with two wings or flaps, which could be closed by means of a spring stilet. These wings represented the hooks of Lallemand's instrument. When the catheter was introduced and the wings at its extremity opened, it was drawn outwards, bringing with it the posterior edge of the fistula; some lint was now placed on the meatus urinarius, the rim of the external end of the catheter was fixed on this lint, and the soft parts were thus pushed back with it. Dupuytren says that he succeeded, in one case, with this instrument.

For obvious reasons, however, it is preferable to act through the vagina, where so much more room is afforded,

and the surgeon can see what he is about. When the fistulous orifice is seated low down, near the meatus urinarius, no great difficulties are experienced; but when it is far up in the vagina all the ingenuity and mechanical skill of the surgeon will be required to conduct the operation to a successful issue.

For removing the edges of the opening, knives or scissors may be employed. Naëgele, Lallemand, and others, employed peculiar shaped bistouries and scalpels; Roux used scissors, but the best and most convenient instrument is a narrow sharp-pointed, knife, with a long handle, and cutting to a short distance only from the extremity. Much stress was formerly laid on the necessity of employing some contrivance whereby the knife might be made to act on some solid support placed beneath the mucous membrane; but this precaution is not necessary. In order to bring the edges of the fistulous opening fairly into view before proceeding to the operation, several methods have been employed. Malagodi dilated the urethra until it was capable of receiving a finger, which he passed into the bladder, and with it pushed down the edges of the fistula until they came within reach of the bistoury. Instead of the finger, a large-sized bougie, made of highly polished whalebone, as proposed by Dr. Hayward, of Philadelphia, may be substituted with advantage. In most cases, however, it will be quite sufficient to employ the speculum for dilating the vagina. When the vagina has been sufficiently dilated and a strong light admitted on the parts, the edges of the fistula may be drawn down by hooks or forceps, various kinds of which have been invented by Dieffenbach, Wutzer, and others.

The portion of soft parts removed by the knife sometimes comprehends the whole thickness of the edges, while by some operators it is confined to the vaginal membrane only. Thus Wutzer drew a line with the point of his knife around the fistulous opening and about three or four lines distant from the free edges. He then raised up the mucous membrane of the vagina with a hook, and removed it from the surface just designated, that is, between the line drawn by the knife and the free edge of the fistula; the surface everywhere exposed for union was hence about three or four lines broad. Dieffenbach's incisions comprehended the mucous surfaces of both the vagina and bladder. In a case recently operated on by Mr. Luke, of the London Hospital, the edges of the wound were so pared as not to enlarge the opening. This was effected by removing triangular slips, the angles of which, at the urethral surface, were only separated by the breadth of the fistula.*

The edges of the refreshed wound must of course be maintained in contact for some time until union can take place between them. Sutures are the best means we can employ for this purpose; but as it is often most difficult to apply them effectually in so narrow a space as the vagina, a great variety of instruments and methods has been proposed to obviate the difficulties of the operation. The simple suture was first tried, but soon abandoned because the threads cut through the walls of the septum too quickly. The interrupted and twisted sutures were then had recourse to, and the former is the one now generally employed. Wutzer,

* Medical Times, Sept. 13th, 1856, p. 263.

however, prefers the twisted suture, whenever it can be conveniently applied, as it closes the wound more perfectly, and is better calculated to prevent infiltration of urine between its edges. Soft threads are employed by some surgeons; but metallic sutures, of fine silver or platinum wire, are preferable. The flaps of mucous membrane having been removed from the vaginal surface of the edges of the fistula, in the way described, the sutures are introduced three or four lines beyond the edge of each flap, and about two or three lines from each other. The needle should traverse, if possible, the muscular coat of the bladder as well as the septum, but not the mucous lining of that organ. To ascertain that the needle does not penetrate the cavity of the bladder, Mr. Brown recommends us to introduce the little finger of the disengaged hand into the bladder through the urethra. While passing the sutures it will often be necessary to fix the edges of the wound with a hook, as otherwise they may give way before the pressure.

As the insertion of the threads is a principal, and frequently most difficult part of the operation, various kinds of needles have been proposed by different operators. For a description of these, I must refer to special treatises on the subject. The surgeon, indeed, should be provided with a variety of needles, as the situation, size, and shape of the fistula will render it necessary to modify the kind of instruments employed. Generally speaking, I would prefer, as an useful form, the articulated needles figured by Mr. Brown.*

* On some Diseases of Women admitting of Surgical Treatment, p. 99, f. 2.

Mr. Beaumont, also, has suggested an ingenious instrument for passing the sutures. It has the form of a forceps, one blade of which carries a needle curved towards its point, and close to the point is the eye of the needle. The other blade is broader on its opposing surface, less curved, and at its extremity has a hole, through which the needle-point and just the loop of the ligature, are carried when the plates are closed. On the back of the broad blade is a spring, which, when pushed forwards, the blades being previously closed, catches the ligature on its point, and holds it at the extremity of the blade.

In using this instrument the operator has only to seize in its points, as he would with a pair of forceps, the border of the fistulous opening; the blades should then be closed, and the ligature will be carried through one lip of the aperture. The opposite border is then in like manner to be seized, and the blades to be again closed and firmly held so. The spring on the back of the broad blade is now to be pushed forwards, by which the ligature will be caught and held at its point. The blades after this are to be opened and gently withdrawn, leaving a double ligature passed through opposite points of the fistulous aperture. Two or more stitches may be made in the same manner, leaving in each a double ligature, so that the quilled or other suture may be afterwards formed.

In many cases the fingers may be employed as needle-holders, and most surgeons will find it convenient to use them whenever they can. When the first suture has been introduced, the ends of the ligature should not be cut off immediately; several inches should be allowed to

remain, as they will assist us much in arranging the edges of the wound, while the remaining sutures are being applied.

As soon as the sutures have been made fast, the tension of the vaginal membrane and subjacent tissues should be relieved by free incisions, as recommended by Mr. Brown, made at four to six lines on each side of the closed wound. The principle on which they act, requires no explanation.

The after-treatment will chiefly consist in obviating the effects of any inflammation which may arise. Mr. Brown advises that the patient should be placed on a water-cushion on her side, the hips being elevated, and the knees flexed on the abdomen. A catheter should be kept permanently in the bladder, the point being turned up behind the arch of the pubes, while the other extremity is fixed to an elastic bag, capable of holding four to six ounces. Wutzer, and many other surgeons, do not agree with the opinion that the catheter should remain permanently in the bladder; they prefer introducing it from time to time. To ensure cleanliness, the vagina should be syringed once a day with cold water. Dieffenbach injected cold water every half hour, and also applied cold to the lower part of the abdomen to prevent inflammation. On the third day after the operation the sutures should be examined, and in successful cases the wound will be found to have united perfectly about the fourth day; but as a general rule, the sutures should not be removed before the tenth or twelfth day; more frequently, however, only a portion of the wound unites, a fistulous orifice of small extent still remaining. Con-

traction may be excited by touching this orifice with caustics, or it may be necessary to repeat the operation of suture more than once.

In the preceding remarks, I have chiefly noticed some general points connected with the cure of vesico-vaginal fistula by suture, but it may be useful to describe more in detail the operation which has been so frequently performed, and with such remarkable success, by my colleague, Mr. Baker Brown, at St. Mary's Hospital; it is the same as the operation performed by Dr. Sims, of Boston, United States, anddiffers from preceding methods in many important particulars.

The patient is placed on her back as in the operation for stone, and the sides of the vagina are drawn firmly asunder by two assistants. The vagina having been thus dilated, and the parts brought well into view, the edges of the fistula are pared with a narrow-bladed straight knife: about a quarter of an inch around the edges is removed, but the incision never includes the mucous membrane of the bladder. Any slight discharge of blood which occurs is removed with a piece of sponge attached to the end of a whale-bone rod—in fact, with a small probang. The next step of the operation consists in applying the sutures, and it is this part which is peculiar to Dr. Sims, who has named it the "clamp suture." The threads are composed of silver wire, not thicker than a horse-hair, and they are fixed to two cylindrical cross bars, each about a line in diameter. These bars are made of silver, or highly-polished lead; their length, as well as the number of the sutures will depend on the size of the fistula, and when drawn

together by the metallic threads, they act on the principle of the clamp.

The needle employed for passing the sutures is spear-pointed, about six inches long in the shaft, and malleable near the handle, to admit of its being bent into any desirable shape; near the extremity is an eye for carrying the threads. This needle, armed with a provisional silk ligature, is pushed into the septum, about one third of an inch from the lower edge of the fistulous orifice, carried across the opening, and brought out into the vagina at a corresponding distance from the upper edge. The loop of the ligature is now secured by means of a tenaculum, and the needle is withdrawn, to be used as before for the other sutures; the operation should commence at the central part of the fissure. A thread of silver wire from twelve to eighteen inches in length, is now secured to the silken thread, which serves to guide it; and the metallic ligatures are substituted for the silken in the ordinary way. The next step of the operation is to secure the ligatures by means of the clamps. The distal ends are fixed to the cross bar by being passed through small holes, made in it to suit the distances between the several points of suture; they are then either wound round the bar, or clamped to it by perforated shot. This done, the free ends of the sutures are drawn down until the cross-bar is brought into contact with the vaginal wall, where it occupies a position just over the distal orifices of the ligatures. The second bar is now easily applied, by bringing the proximal ends of the ligatures through its openings, by pushing it against the vaginal wall, until the fistulous orifice is closed, and fixing the wires as before, on split shot, by twisting them

with the forceps. The ends of the ligatures are cut off close to the shot, and the fistula is firmly bound together with a metallic clamp on either border. The object of employing the shot is to make them act as so many knots, by which the clamps are prevented from slipping. The sutures should not be removed before ten or twelve days, and it may be necessary to retain them longer.

According to Dr. Sims, this suture never ulcerates; there may be some trouble in removing it, for the clamps sometimes become imbedded in the mucous membrane of the vagina, which throws up granulations around them.

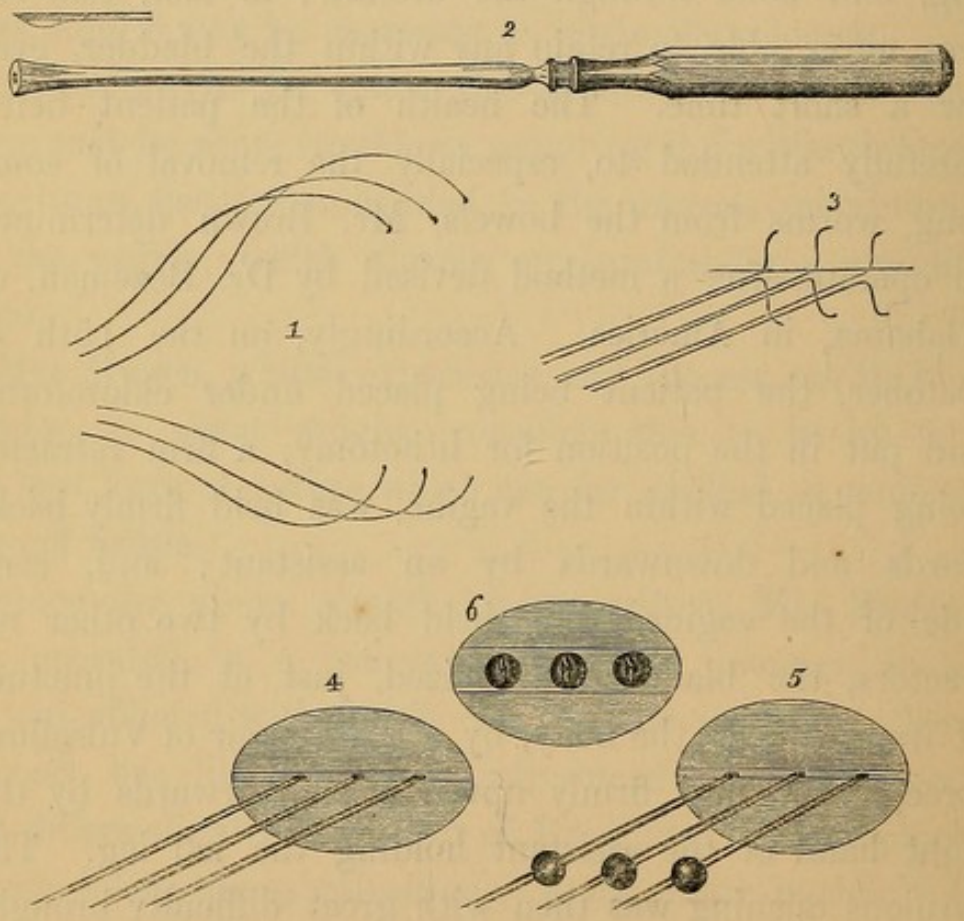
Mr. Brown, whose experience and success entitle his opinion to great weight, considers this to be by far the best form of suture which can be applied to vesico-vaginal fistula.

Since the above remarks were written, Mr. Brown has operated in a somewhat different manner, in a patient afflicted with fistula close to the os uteri. The method has likewise been introduced from America, and differs slightly from that of Dr. Sims, the principal change being the substitution of a flat silver button for the cross-bar clamps. The following is a short account of the operation :

Deborah P—, æt. 22, was admitted into St. Mary's Hospital, Sept. 22d, 1856. She stated that she was delivered of a still-born male child on the 15th July, by instruments, after being forty-eight hours in labour. She was shortly afterwards seized with an attack of fever. Eight days after delivery she discovered that the urine dribbled away, after which it all seemed "to pass by the wrong passage." On examination per

vaginam, Mr. Brown discovered a fistulous opening close to the os uteri, about the size of an ordinary director, which instrument could readily be passed within the bladder, through the opening into the vagina. It appeared that all the urine passed through this opening, and none through the urethra; in fact, that she was never able to retain any within the bladder, even for a short time. The health of the patient being carefully attended to, especially the removal of some long worms from the bowels, Mr. Brown determined to operate after a method devised by Dr. Bozeman, of Alabama, in America. Accordingly, on the 15th of October, the patient being placed under chloroform, and put in the position for lithotomy, a firm retractor being placed within the vagina, was held firmly backwards and downwards by an assistant; and, each side of the vagina being held back by two other retractors, the bladder was seized, just at the juncture of its neck with the body, by a strong pair of Vulsellum forceps, and held firmly upwards and forwards by the right hand of the assistant holding the left leg. The fistulous opening was then with great difficulty brought into view, and the mucous membrane divided, by a sharp knife, completely around the opening, about the eighth of an inch in depth. Three silver-wire sutures, eighteen inches long, were then passed by a needle held by the porte-aiguille, and which are shown in fig. 1, p. 308. The two ends of each wire were then brought together by an instrument, as represented in fig. 2, thus leaving the parts in apposition (fig. 3). A silver button, described in fig. 4, was then carefully passed over the end of each double suture, and a perforated

shot passed over each wire, as shown in fig. 5, and pressed down upon the button, and then firmly pressed by a pair of long strong forceps. The wires were then cut off close to the shot, leaving the parts as represented in fig. 6. A piece of lint dipped in sweet oil was



then introduced within the vagina, the patient placed in bed on a water cushion, on her side, and a bent catheter with a bag attached to it was inserted within the bladder, and allowed to remain there. Two grains of opium were given directly, and one grain every four hours afterwards for the first twenty-four hours, and afterwards one grain every six hours, and a generous diet, with wine, allowed daily. The lint was removed on the second day, and the vagina washed out night

and morning with tepid water. All the urine passed freely through the catheter. On the 24th, Mr. Brown carefully removed the button and the sutures, and found the most perfect union had taken place throughout the whole extent. On the 26th, the bowels were relieved, for the first time, by castor oil and enema, and the catheter was removed for three hours, at the end of which time the patient passed urine comfortably, with no escape per vaginam. On the 27th, the catheter was removed entirely, and she was allowed to sit up and walk about a little. On the 28th, she was up and about all day; she was able to retain the urine for four hours, and to pass it well. On the 30th, Mr. Brown made a most careful examination, and found the parts firmly united and without the slightest escape of urine, even after a long and tedious investigation. Mr. Brown observed that this method of operation had convinced him that cases hitherto intractable to treatment will be found to be curable by this operation.*

When the loss of substance is considerable, the edges of the fistula cannot be brought together by any form of ordinary suture. For these unfortunate cases Dieffenbach and Jobert have employed special modes of operating. Dieffenbach had recourse to a metallic suture, which he applied in the following manner. The bladder was first returned through the fistulous orifice and retained by a piece of sponge introduced into the fissure. One edge of the fistula was then drawn down, and a narrow slip was cut off from it; the edge of the bladder

* Lancet, November 15th, 1856, p. 540.

was also cut off at some lines' distance from the edge of the vagina. Two leaden threads were then carried through the edges of the vagina, the bladder being left untouched, and were drawn towards each other until the soft parts underwent a considerable degree of tension. To relieve this, and allow closer approximation of the edges of the wound, Dieffenbach now had recourse to the method employed in cases of cleft palate. With the knife he divided deeply the walls of the vagina on either side of the fistula, thus isolating a portion of the vagina, which was equal to about one fourth of its whole width. These incisions liberated the edges of the fistula much, which could now be drawn closer than before by the suture; but to obtain further improvement the operator again divided the cellular tissue connecting the vagina to the pelvis, first on one side and next on the other. By steadily drawing the leaden threads together, the edges of the fistula were brought so far together that no further tearing of the parts was to be apprehended; the refreshed edges were, therefore, now united by the interrupted suture; the leaden threads were drawn closer together, and cut off, so that only two turns remained.

Mr. Jobert, instead of stitching up the opening, endeavoured to cover it with a Taliacotian flap. His operation must be a difficult one, and not likely to be adopted. The flap was taken from the labium, or from the fold between the skin and buttock. Of four patients treated in this manner, two are said to have been cured, one died, and with one the operation failed.

Recto-vesical fistula occurs when there exists an ab-

normal communication between the bladder and rectum, through which the urine or fæces indiscriminately pass. As the urine, however, finds its way into the rectum much more easily than the fæces do into the bladder, the usual symptom of the accident is the discharge of urine through the anus. Flatus may pass through the urethra, and occasionally fluid fæces. The unnatural discharge of the contents of the bladder and bowels does not, of course, prove that the lesion exists between the bladder and rectum, because a portion of the intestinal canal may open into the urinary reservoir; an examination of the parts must therefore be made; in most cases the opening will be detected by an instrument introduced into the bladder; and should any doubt arise, the speculum ani must also be employed.

The inconveniences which result from this accident are less than we might anticipate. The whole of the urine seldom passes away through the rectum and the patient has the power of partially retaining it in the bladder. On the other hand, many years may elapse before the fæces begin to make their way into the bladder. The dribbling of the urine through the anus produces excoriation of the surrounding parts, and is very distressing, as it is difficult to apply any convenient reservoir for its reception. The passage of fecal matter into the bladder may give rise to irritation of that organ, retention of urine, the formation of calculous concretions, &c.; but it is astonishing how long the bladder will sometimes bear the presence of foreign bodies without apparently being irritated by them. Richerand and Cloquet attended a man who, thirty

years previously had received a gunshot wound in the groin, involving the bladder and intestinal canal; both external wounds healed in about a year, but after each evacuation of urine a quantity of flatus passed through the urethra; this continued for twenty years, when fecal matter likewise passed through the urethra whenever the bowels were loose. If the urine was retained for any considerable time in the bladder, a portion of it passed through the rectum on making water. The patient was thin and weak, but he had not suffered from his long infirmity to any dangerous extent.*

Calculus, ulceration of the bladder, and wounds, are the most frequent causes of this affection; it may also arise from ulcers and wounds which act from the side of the rectum towards the bladder. The recto-vesical operation for calculus was at one time a frequent cause of the accident, and it has followed simple puncture through the rectum for retention of urine.

The mode of treatment to be adopted will be modified according to the extent and nature of the fistulous opening, its date, the age and general condition of the patient.

When the health is good, the accident of recent date, and produced by a cutting instrument, nature sometimes effects a cure without the aid of a surgical operation. The indications of treatment, in such cases, are manifest. The patient should be confined to the recumbent posture, and the bladder and rectum be kept as completely

* Jour. des Prog., t. x, p. 240.

empty as is possible. These objects will be effected by the constant use of the catheter, the administration of opium, and the frequent washing out of the lower bowel by emollient lavements. In this way the fistulous opening may sometimes heal spontaneously; and the closure may be accelerated by the use of caustics, or the cautery if necessary. Dupuytren frequently employed caustics, if not with the effect of completely closing the fistula, at least with great relief to the patient, by diminishing the escape of urine. He repeated the cauterization after forty-eight hours, and five or six applications were often sufficient to afford considerable relief. When the above means fail, or when circumstances render them inapplicable, we may have recourse to operative proceedings. The interrupted suture may be tried, as in cases of vesico-vaginal fistula. More commonly, surgeons are content with laying the parts open, either down to the anus, or through the sphincter muscles.

In a case of recto-vesical fistula after lithotomy, Mr. South divided the sphincter ani from the fistula into the perinæum, with the object of producing a perineal fistula, which would be much more easily managed than the original one. After completely laying open the parts, the edges of the fistulous orifice were drawn down with Lisfranc's tenaculum, pared off, and united at their upper part by a single interrupted suture. The communication between the bladder and rectum was thus cut off, but the lower part of the wound was left open in order to establish a fistula in perineo. The after treatment was continued for six months, the

fistulous orifice between the bladder and rectum being freely touched with lunar caustic, until it had diminished to the size of a large goose-quill. Soon after the patient left the hospital, much relieved, but not cured by the operation.*

* Chelius's Surgery, by South, vol. i, p. 749.

CHAPTER XV.

HERNIA AND DISPLACEMENT OF THE BLADDER.

Displacements of the bladder are not of frequent occurrence. They consist of hernial displacements, and that very rare form which some writers call inversion, but which I think should more properly be termed eversion of the bladder. In eversion the organ is turned inside out, in a more or less complete manner. This can happen in two ways only, either through the dilated urethra, or through an accidental opening in the wall of the bladder and some neighbouring septum.

We are indebted to the late Mr. Crosse for the only original account which exists of eversion through the urethra.* Mr. Crosse met with one case, and another example presented itself about the same time to Dr. Murphy.†

In the case communicated by Percy to Chopart, it does not seem certain whether the tumour was formed by the mucous membrane of the bladder or by the everted walls of the organ; Percy, however, considered it as a true example of eversion.

* Trans. of Prov. Med. and Surg. Assoc., vol. xiv, p. 185.

† Med. Gazette, vol. xi, p. 112, Jan. 19, 1833.

When this displacement occurs, a small tumour is observed projecting between the labia, in the direction of the orifice of the urethra. In Mr. Crosse's case the tumour was about the size and shape of a walnut. It was of a florid red colour and somewhat granulated on the surface, so as to resemble a large strawberry. Towards the posterior part of the tumour, and on its sacral aspect, there was an aperture which was supposed to be the entrance into the displaced urethra: a small female catheter could be passed through this aperture into what seemed to be the bladder. Near the posterior junction of the labia, and concealed in a fold of the tumour, were two orifices, not far asunder from each other, and from which the urine oozed. The tumour was easily returned by pressure, and the canal through which it retired was found to be the urethra, dilated sufficiently to admit the little finger, although the patient was only between two and three years of age.

The subject of Dr. Murphy's case was also a female child four years of age. The tumour was pyriform, depending by its apex from the upper angle of the labia, of a dark mahogany colour, and about the size of a small hen-egg. The orifice of the meatus urinarius could not be detected; but on making slight traction of the tumour, the eversion was rendered complete, and the orifices of the ureters were brought into view. Its return was readily effected by steadying the neck of the bladder with the thumb and forefinger, while the fundus was pushed upwards by the end of a gum-elastic catheter.

It is remarkable that in the two cases just noticed

the nature of the affection was mistaken at first, and operations were about to be performed, one of which must have been necessarily fatal. The diseases with which eversion of the bladder is most likely to be confounded are vascular growths from the mucous surface of the urethra, or protrusion of the relaxed lining membrane of the bladder beyond the external orifice of the urethra. Yet when the bladder is completely everted it can hardly be mistaken for any other morbid production.

The peculiar feel of the tumour, the manner in which it yields under pressure, the oozing of urine from its surface, the way it is girt by the urethra, and above all the existence of the orifices of the ureters at its lower part, will point out the true nature of the affection to the careful practitioner.

Eversion of the bladder may also take place through an artificial opening in its own wall and in that of the vagina. In most cases of vesico-vaginal fistula, accompanied by extensive destruction of the soft parts, the mucous lining of the bladder projects more or less into the cavity of the vagina—a plug is, in fact, formed by the partially everted bladder. The eversion may be even complete; Mr. Crosse saw a case in which the bladder, everted through a fistulous opening, had escaped between the external labia, forming there a tumour from which the urine continually dribbled at points found to be constituted by the termination of the ureters. A similar case was communicated by Dr. Howard, of Columbus, to Dr. Gross. The patient, during her first labour, five years previously, had received an extensive laceration of the vesico-vaginal septum and perinæum.

Four years afterwards she gave birth to another child, and some months after that event she observed a tumour in the vagina. On examination, Dr. Howard discovered complete eversion of the bladder, which hung through the vulva in the form of a red mass, as large as an orange, and of a globular shape; its rounded and rather narrow pedicle could be traced to the edges of the fistula, and the orifices of the ureters were seen at its posterior extremity within the vagina. After two unsuccessful attempts, Dr. Howard returned the tumour through the fistulous opening.*

In cases of this kind the surgeon can only hope to afford some relief by palliative means. After reduction of the everted bladder, Dr. Barnes's bottle, or some other instrument of a similar kind, should be had recourse to.

A portion, or even the whole of the bladder, may be displaced in such a way as to produce a hernial tumour. In the male, the protrusion usually takes place through the inguinal canal into the groin or scrotum; in the female, the displaced organ descends into the vagina, or towards the floor of the pelvis, giving rise to the accident which is called vaginal cystocele, and often prolapsus vesicæ.

Hernia of the bladder is said to occur most frequently amongst males, but if we include cases of vaginal cystocele amongst herniæ, the proportion must be reversed; it will be found that displacement of the bladder happens much more frequently in the female. The relative disposition of parts in the male and female pelvis readily explains why this happens.

* Dr. Gross, l. c., p. 150.

Inguinal cystocele exists when the bladder protrudes through the inguinal canal into the groin or scrotum. The tumour may contain a portion of the bladder, or even the whole. Beaumont relates a case of the latter kind, where the scrotum contained the whole of the urinary bladder, in which a large calculus was also lodged. The hernia may be single or double; it presents great varieties in size, external appearance, &c., and it may be complicated either with protrusion of the bowels, or formation of calculus within the displaced portion of the bladder.

The causes of inguinal cystocele have not been clearly explained. There must, however, exist some peculiarity, either congenital or acquired, in the abdominal walls, or in the shape and size of the bladder, which brings it nearer than natural to the opening by which it protrudes. Sir A. Cooper attributes the cause to a relaxed state of the bladder, and suspects that the protrusion may also be promoted by neglect to empty the bladder at the time required. This probably holds good in many cases. It is necessary to the occurrence of a cystocele, that the bladder should be placed immediately behind, or very close to the ring, and that it should hold that situation when empty; for the distended condition of the organ is obviously so unfavorable to a protrusion that it can hardly be deemed possible in that state. Repeated distension of the bladder from any cause must therefore be regarded as particulary disposing to this kind of rupture, and the lateral extension of the viscus in pregnancy facilitates its occurrence. We often discover the bladder, on dissection, adhering in such cases

to the back surface of the abdominal muscles, instead of having its fundus behind the pubes.

It is probable that, in many cases, the inguinal canal may have been prepared for the reception of the bladder by the previous descent of intestine; the hernial tumour will then contain both bladder and intestine; or the bowel may have returned into the abdomen, and left the sac free for the reception of the bladder. However this may be, it is certain that, as a cystocele may give rise to a protrusion of omentum, so an enterocele or epiplocele may cause a descent of the bladder. The symptoms of the latter occurrence have not been observed in many instances until long after the patients have been incommoded by an intestinal or omental hernia, and it has even been suggested that the former is always preceded by the latter affection; this is, however, contrary to experience, which has shown us that a protrusion of the bladder may exist alone.

The manner in which an ordinary omental or intestinal rupture may become complicated by the addition of a cystocele, can be easily understood when we consider that the peritoneum forming the sac is placed immediately behind the ring, and continued over the fundus of the bladder. If the original hernia be neglected, its increase elongates the hernial sac, gradually drawing into the ring that portion of the peritoneum which is attached to the bladder, and the bladder itself, if it be disposed to yield to this force. Thus a portion of the organ becomes situated behind the cavity of the first rupture, and it passes through the ring just as the fixed portion of the large intestines does in the gradual

increase of a common scrotal rupture. The anatomical description is the same in this as in the preceding case. The protruded portion of the bladder is here interposed between the original hernia and the spermatic chord. The posterior surface of the sac, at its upper part at least, consists of the peritoneum covering the fundus and back of the bladder, and the proportion of the sac formed in this way depends on the extent of the protrusion.

A bubonocele taking place through the abdominal canal gradually brings the upper opening behind the lower one, so that we can conceive the possibility of the bladder being drawn through the ring in the subsequent increase of the swelling. But the relative positions of the opening and the bladder render the occurrence of cystocele more probable as a consequence of internal inguinal rupture.

Larrey relates a case where the organ protruded through a wound made by a bullock's horn; but this cannot be strictly regarded as an example of hernia.

The investments of the hernial mass differ in different cases. There may be two sacs, or one, or no sac at all. Thus, if we conceive the bladder to elevate the peritoneum above the level of the internal abdominal ring, and then to protrude through the opening with that portion of its walls which are uncovered by peritoneum, it is evident that we would find a cystocele without any sac; such an occurrence, however, must be very rare; more commonly the fundus, covered by its serous investment, protrudes through the ring; or a portion of the bladder, covered or not by peritoneum, may be found in the sac of an intestinal rupture. In old cases, the walls of the

bladder are frequently adherent to the adjacent intestine or sides of the sac; and the viscus may become greatly expanded as in the following case, the history of which is given by Mr. Clement. In the patient referred to, the entire bladder had passed through the inguinal canal into the scrotum, where it had become enlarged by distension, so as to form a tumour of enormous magnitude. The patient, a very corpulent man, about sixty years of age, had been troubled with the swelling for twenty-five years. It was small at first, and slowly increased to its immense size, having varied but little during the greater part of that time. The patient could not make water without first raising the rupture towards the belly, and then rolling it about for a short time, when the urine would pass in a full stream, though he was unable to make much at one time. He had repeatedly suffered from constipation and slight attacks of hemiplegia; but his health had been good in other respects, and he had been accustomed to take regular, and occasionally, laborious exercise. The swelling had produced no alarming or dangerous symptoms until about a fortnight before death, when obstinate constipation came on, with paralysis of the left side. To these affections was joined stillicidium urinæ, for which the catheter was used several times; but not more than a tea-cupful of urine was drawn off on each occasion. Although purgatives and enemata produced no relief of the bowels, the symptoms were rather referable to retention of urine than to constipation. The pain and other symptoms increased, and delirium and death supervened. The true nature of the hernial tumour does not seem to have been suspected during life. The circumference of

the swelling was twenty-nine inches; its length fourteen inches and three quarters. The whole penis was retracted within the integuments, and the urine had been discharged through an opening resembling the navel. One of the testicles could be distinctly felt at the middle of the tumour; but the other was not discoverable before the parts were dissected. Although the rupture was so large as to extend generally over the pubes, and occupy both inguinal regions, the protruded parts obviously came through the left abdominal ring. When the inguinal canal had been exposed and opened, a portion of the colon was seen traversing it, distended with feces, but not inflamed, nor compressed, as the entire hand could be passed through the opening. On continuing the dissection, and after removing the testicle, the tumour was found to consist of a sac, resembling an enormous hydrocele, from which two quarts of fetid urine escaped by the rupture of a part which had become red and pointed before death. It was now discovered that the urinary bladder had passed through the abdominal ring, so as to form the immense scrotal tumour already described.

The part undergoes further changes after it has passed through the ring. It becomes contracted in the opening, and expands again below. Mr. Keate found it contracted at the ring, dilating itself again in the abdomen and pelvis, and forming a kind of double bag, divided by the ring. And the same change had occurred, to a still greater extent, in a case operated on by Mr. Pott. He discovered a membranous bag, growing narrower as it proceeded upwards; and a membranous duct, about the size of a

large wheat-straw, was continued from its upper end through the ring. The urine flowing through this, when it was divided, proved the case to be a hernia of the bladder.

The cystocele is occasionally complicated with the formation of calculi in the protruded part of the bladder; and it is, indeed, to be wondered that this does not more frequently occur, when we remember the irritation to which the bladder is exposed, and the manner in which the urine stagnates in the protruded sac. Many cases of the complication now spoken of are on record; and it led to some curious mistakes formerly, when the nature of the complaint was less known. Thus Petit felt several calculi in a hernial tumour, but they subsequently disappeared, for they had been discharged through the urethra. Sala had a patient who presented the rational symptoms of calculus, but the stone could never be felt with a sound; after death the calculus was discovered in a portion of the bladder engaged in the inguinal canal. Vidier relates a case where a calculus contained in a cystocele was mistaken for bubo, and caustic applied, with the effect of establishing an urinary fistula. Even Pott himself once cut into a cystocele through mistake.

Calculi may, likewise, be found in cases of cystocele in the female. In a case related by Hartmann, a pudendal cystocele contained a stone weighing three ounces. Cloquet and other writers mention several examples. Cruveilhier, however, found a calculus in the undisplaced portion of the bladder.*

* Anat. Path., liv. xxvi, p. 3.

The symptoms indicating this displacement, are difficulty in making water, with occasional retention; sudden escape of a large quantity of urine upon introducing a gum-elastic catheter; discharge of mucus from the urethra; enlargement of the hernial swelling after the urine has been retained; and the escape of urine from the urethra upon pressure of the tumour.

The symptoms of cystocele will be different, according as the protruded portion is full or empty; confined to the groin, or continued into the scrotum; and simple, or combined with intestinal or omental rupture. When the part is empty, its volume is not considerable, the sides collapse, and examination discovers nothing but a soft membranous substance rolling under the fingers. The swelling is sometimes round and uniform, sometimes elongated and irregular; when compressed, it causes a desire to make water, and sometimes the involuntary flow of urine; and it increases and diminishes in size according as the bladder is full or empty. There is often a constant pain in the region of the kidneys and perinæum. But the most characteristic circumstance is the state of the urinary evacuation. When there is frequent desire to expel the urine, with occasional retention; when the tumour increases after retaining the water for some time, and is diminished, or entirely disappears on voiding the urine, the case must be a cystocele. The patient sometimes feels unable to expel the urine, without elevating and compressing the tumour, but he can accomplish it easily by these means. After voiding all that he can, a further desire to make water is excited by pressing the swelling.

Should retention of urine have occurred, it will be

observed that the tense tumour usually formed above the pubes by the distended bladder is absent; but we must not forget that a small portion only of the bladder may be contained in the groin. M. Civiale insists on the necessity of our studying the manner in which the urine is excreted while a catheter remains in the bladder. Thus, if the body of the organ has been emptied by the catheter, and if a fresh quantity of fluid flows through the instrument when pressure is made on the tumour, we have convincing proof that some portion of the urinary reservoir is contained in the hernial sac. Unless the catheter be employed, the urine which stagnates in the tumour might be merely forced into the bladder, and an useful means of diagnosis frustrated. When the bladder has descended into the scrotum, and is full of urine, it might be mistaken for hydrocele. The dysury, the power of diminishing the swelling by pressure, and desire of making water consequent on this, sufficiently distinguish the case. To the peculiar symptoms of cystocele will be added those of an intestinal or omental rupture, when the affection is complicated.

In some cases the protrusion of the bladder has been attended with no symptoms. Its existence was not known until after death in Mr. Keate's case, where the greater part of the viscus had passed into the scrotum; and the same observation may be made concerning a case related by Arnaud.

Surgical treatment can avail little in hernia of the bladder. The part cannot be replaced, and we must therefore be contented to support the tumour by means of a suspensory bandage. If its existence were discovered at an early stage, perhaps it might be reduced by the

constant pressure of a truss with a hollow pad. It seems to be hardly susceptible of strangulation; but if such a circumstance should occur, the operation must be resorted to, as in other cases of hernia. If a stone be discovered, we ought to remove it by an incision. No ill consequences followed in two instances where openings were made in the protruded portion of the bladder.*

In all cases particular attention should be paid to not allowing the urine to stagnate in the protruded sac. The catheter should be frequently used.

Inguinal cystocele may likewise occur in the female, especially during pregnancy; but in the great majority of cases the bladder descends behind the pubes into the vagina, forming a tumour which surgeons call vaginal cystocele, while accoucheurs generally denominate the complaint prolapsus of the bladder. The causes of the accident are well understood, and in most cases sufficiently obvious. Relaxation of the walls of the vagina affords a predisposing cause, joined to which, any unnatural pressure on the bladder may force it downwards and inwards on the vagina, where the least support is afforded. Hence the complaint is often the result of difficult and protracted labours, and the displacement is particularly liable to occur in those unfortunate cases where the support, which should be afforded by the pelvic floor, has been lost through laceration of the perinæum. In many other cases the bladder is mechanically brought down by prolapsus of the vagina and uterus.

Inconvenient as this accident is to unmarried females,

* Acad. de Chir., tom. ii, pp. 11, 13.

it has occasioned the greatest embarrassment during delivery; impeding the passage of the head, or misleading the accoucheur. Dr. Hamilton mentions a case in which the prolapsed bladder was mistaken for the membranes, and punctured; and Dr. Merriman records one, in which a distended bladder, pushed before the head of the child during labour, was actually opened under the notion that it was a case of hydrocephalus. The obstacles which the accoucheur may have to encounter in cases of this kind, are well illustrated by an interesting case, related by Dr. M'Cormack, of Portadown. Although vesico-vaginal fistula had existed for seven years, the bladder formed a large tumour at the entrance of the vagina, and delivery was only effected by perforation of the child's head.*

These cases seldom come under the notice of the surgeon, until the ordinary means of relief have failed. The bladder descends behind the pubes, carrying before it the wall of the vagina, and forms a soft rounded tumour at the entrance of the vulva. The patient experiences more or less difficulty of making water, and on introducing a catheter into the urethra, we find that canal drawn downwards, sometimes to such a degree that it is impossible to reach the bladder.

The symptoms of prolapsus of the bladder are well marked. The patient experiences a bearing down sensation, with frequent desire to pass urine; there is also a peculiar pain, with a sensation of tightness or dragging about the navel. If a catheter can be introduced, we feel its point in the tumour, which is greatly diminished

* Lancet, Feb. 1850, p. 204.

in size when the bladder is emptied. It increases, on the contrary, when the patient makes a strong effort to discharge urine.

If the finger be passed up the vagina behind the tumour we can generally distinguish the neck of the uterus above, and thus determine that the swelling is not occasioned by prolapsus uteri. In severe cases the symptoms are often extremely distressing, for the patient is unable to empty the bladder completely, or may even suffer from complete retention of the urine, with its disastrous effects. The bladder becomes irritable from stagnation of urine in the displaced cavity; the fluid is altered in quality, and deposit of calculous matter occasionally takes place.

When the bladder descends a great way, so as to form a tumour beyond the labia, the only effectual mode of relieving the disease is by introducing something into the vagina—an egg-shaped pessary, or even one of the round pessaries, adapted to the capacity of the dilated parts, ascertained by a trial of instruments of different diameters. If the bladder has not descended, so as to make its appearance externally, a pessary may not be necessary; and in married women especially, it is desirable that this instrument should not be used. When the descent is beginning in this manner, it should be our principal indication to keep the bladder empty, and to tell the patient to abstain from all urging, a rule to be observed with the utmost strictness, as the infraction of it must increase the descent. Lotions of alum, of sulphate of zinc, of sulphate of copper, of galls, and so on, are recommended of various strength, according to the effect produced; and if a patient becomes

pregnant, I should recommend, as before, that she should be confined to the horizontal position for a few weeks after delivery, in order to allow of the vagina contracting itself, and giving the bladder a more effectual support.

Should these measures fail, Mr. South recommends us to excise a small portion of the mucous membrane of the vagina, and unite the edges by ligature, so as to cause contraction of the canal. He relates a case in which this method was employed with considerable benefit.

Mr. Lightfoot, of Newcastle-on-Tyne, has successfully applied Fricke's operation for prolapsus uteri to a very severe case of prolapsus of the bladder.*

The tumour, which was of the size of a fist, protruded beyond the labia. Six strong ligatures were applied; they came away on the sixth day, and the patient was enabled to resume her usual household occupations within three weeks.

Benefit may result from the operations recommended by Mr. South, Fricke, Roux, and others, in cases where the pressure on the pelvic outlet is not great. When the vaginal cystocele, however, has been produced by prolapsus or procidentia uteri, more effectual measures are required. My colleague, Mr. Baker Brown, has proposed and practised an operation which has been attended with brilliant success.

The following is the mode of operating which Mr. Brown adopts:—The patient being placed in the position for lithotomy, an assistant holds up the tumour with Jobert's bent speculum, and presses it under the

* Lancet, 1841, vol. i, p. 322.

pubes in its natural position. A piece of mucous membrane, about an inch and a quarter long, and three-quarters of an inch broad, is then dissected off longitudinally, just within the lips of the vagina. The upper edge of the denuded part being on a level with the meatus urinarius, the edges are drawn together by three interrupted sutures, this being repeated on the other side of the vagina. The next stage of the operation consists in dissecting off the mucous membrane laterally and posteriorly in the shape of a horse-shoe, the upper edge of the shoe commencing half an inch below the lateral points of denudation, taking care to remove all the mucous membrane up to the edge of the vagina where the skin joins it. Two deep sutures of twine are then introduced about an inch from the margin of the left side of the vagina, and brought out at the inner edge of the denuded surface of the same side, and again introduced at the inner edge of the pared surface of the right side, and brought out an inch from its margin, thus bringing the two vascular surfaces together, which are then kept so by means of quills, as in the operation for ruptured perinæum. The edges of the new perinæum are lastly united by interrupted sutures, and the patient placed in bed on a water-cushion. Two grains of opium are given directly, and one grain every six hours; simple water-dressing applied to the parts; beef-tea and wine for diet. A bent metallic catheter, to which is attached an elastic bag to catch the urine, is introduced into the bladder; by this means the bladder is constantly kept empty.

The object sought in this operation is the contraction of the calibre of the vagina, which, as may be imagined,

is enlarged and flabby. The first step of the operation is directed to the contraction of the vagina laterally, so as to prevent the tumour from falling down from above; the second step of the operation is for the purpose of contracting the vagina posteriorly; and thus in the end, by contracting the orifice of the vagina at least two-thirds, and by so adding to the extent of the perinæum, that, should the prolapsus not be restrained by the lateral contractions, it cannot extrude beyond the orifice of the vagina, but must necessarily fall upon the new perinæum. The after treatment in most particulars resembles that pursued after the operation for ruptured perinæum. Opium is given to allay irritation and pain, and to prevent defecation; the strength is supported by nourishing diet and wine; water-dressings are applied; and perfect repose is enjoined. The use of injections is, however, contra-indicated; for the sutured parts must not be interfered with in any way. It is of the greatest importance to keep the bladder emptied; and this point is best secured by retaining a catheter in the bladder, with a bag to receive the urine as it escapes. After the seventh or eighth day, according to the integrity of the union of the parts, the patient may pass the urine resting on her hands and knees.

The time for the removal of the sutures must be regulated by the circumstances of each case; but, in general, the deep ones may be withdrawn from the third to the fifth day, the others a few days afterwards.

CHAPTER XVI.

THE CHEMISTRY OF URINARY CONCRETIONS.

The knowledge of urinary concretions in early times was very limited. Pliny, indeed, enumerates many remedies for stone and gravel; but these are commonly of a very ineffectual character. Paracelsus conceived that urinary concretions possessed an analogy with the tartar which urine deposits. He taught that a saline spirit unites with an earthy principle which is always present in the fluids of the body, and that by this union tartar or calculus is produced. Though Paracelsus in many respects was in advance of his age, especially on points of chemistry, he certainly added little, by these speculations, to the knowledge before possessed of urinary calculi. Van Helmont made the important observation, deduced from experiments, that urinary concretions are essentially different from stony bodies. He added, that such concretions are not derived from matter contained in the food and drink. He revived an experiment made some centuries before by Raymond Lully, viz., mixing what was then called spirit of urine, namely, solution of carbonate of ammonia with rectified spirit of wine, by which a white precipitate

was obtained. This white precipitate was termed the offa Helmontiana, and was plainly the carbonate of ammonia thrown down owing to its insolubility in spirit. After this period more correct views began to be entertained as to the nature of urinary concretions. Hales confirmed what Van Helmont had taught as to the great difference between common stones and urinary concretions, by showing how large a quantity of air the latter gave off under the action of heat. He directed his attention to discovering a universal solvent of these concretions, in which, however, he necessarily failed. Subsequently, Boyle, Whytt, Alston, and Slare, engaged in the investigation of this subject. Whytt proposed lime-water as a remedy in calculous disorders. Alston showed that though lime-water is, to a certain extent a remedy, yet that it is not a solvent of these concretions. The tendency of the urine to concrete, so as to encase foreign bodies accidentally introduced into the urinary passages, was fully investigated, and numerous histories of this character, in both sexes, are given throughout the last century. Early in the same century correct views of the nature of the urinary concretions began to be entertained in the Leyden school. It was taught that the nuclei of such concretions are derived from the kidney, or from the bladder. Van Swieten held that the rudiments of calculi exist in the urine of the most healthy; that such concretions form by the coalescence of like elements; that if the urine be passed before the tendency to this coalescence of elements takes place, there is no concretion; that this tendency is exerted more or less slowly in different individuals, and that under this view the first concretion

may take place either in the kidney or in the bladder; finally, that there is no ground of fear unless there is a too rapid tendency to the concretion of the elements of calculi within the urinary passages. Van Sweiten pronounced those fortunate whose urine shows no such tendency to rapid deposit after being passed, and congratulates himself on being of the number.

In 1776, Scheele discovered uric acid. All the calculi that he examined contained this substance. He described it as a peculiar substance, possessed of acid properties; soluble with effervescence in nitric acid, the solution affording a pink colour when evaporated, without too much heat, to dryness. This substance was first termed lithic and afterwards uric acid. Scheele found all urine to contain uric acid, thus confirming what Van Swieten had remarked as to the presence of the element of calculi in urine. Soon after, Bergman discovered lime in certain calculi. After this period little advance was made until Wollaston published his treatise in 1797. In his paper three calculi are described, besides that which Scheele discovered, namely, the fusible, the mulberry, and the bone-earth calculi. The mulberry calculus had been known to surgeons for some time, owing to its peculiarity of appearance. Smithson Tennant had remarked that the fusible calculus was not consumed by heat, like those examined by Scheele and Bergman; he found that this calculus passed into an opaque glass before the blowpipe, and conjectured that it contained phosphate of lime along with other salts. Wollaston showed that this calculus contained ammonio-phosphate of magnesia. He proved, besides, that oxalate of lime is contained in

the mulberry calculus, also that the smaller calculi, termed hemp-seed calculi, contain the same substance. He also taught that the bone-earth calculus contains phosphate of lime, differing, however, from the phosphate of lime of the bones. A few years after, Fourcroy and Vauquelin made an important contribution to the chemistry of urinary calculi, though in their treatise no mention whatever is made of what Wollaston had discovered and taught. These chemists announced the presence of urate of ammonia and silica in urinary concretions. In 1810, Wollaston made known his discovery of cystic oxide as a urinary concretion. In 1817, Dr. Marcet published his valuable work on urinary concretions; in 1821, Dr. Prout, in his treatise, threw much light on this subject; while, more recently, the works of Dr. Golding Bird, Dr. Bence Jones, and M. Becquerel have considerably added to our knowledge.

Urinary calculi being more or less regularly deposited around a nucleus, usually assume the globular or ovoid form after remaining long in the bladder; but this is by no means universal, especially in the case of renal concretions, which are often very irregular, moulded to the pelvis of the kidney, and even branched like a coralline, while those found in the ureter are cylindrical. Even vesical calculi often affect shapes widely different from the globular or ovoid. Many of them, especially when two or more exist at the same time in the bladder, have several flattened surfaces, produced by mutual attrition, which give them a polyhedral aspect. In other cases the globe or ovoid is compressed laterally, and changed to the amygdaloid shape, and in cases in which a portion of the calculus is embraced by a fold of the

mucous membrane or encysted, the exposed part continues to increase in bulk by successive deposits, so that ultimately the encysted portion forms a sort of pedicle to the entire calculus.

The character of the surface is as variable as the form; it may be either smooth, or even polished, covered with minute crystals, or more or less rough and tuberculated, as in the mulberry calculus.

The colours of calculi vary from white through pale yellow to brown, brownish-green, and even almost to black. Phosphatic calculi are often white; those of uric acid vary from yellow to brown; those of xanthic oxide have a cinnamon brown tint; while calculi of oxalate of lime vary from yellow to yellowish-brown, brownish-green, or even blackish-green.

The size and weight of calculi are even more uncertain. They ordinarily vary from a few grains to several ounces, the great majority being under one ounce in weight. A month ago I removed, in the presence of Mr. Buxton Shillitoe and others, one which weighed only five grains. Dr. Gibson, of Richmond, United States, extracted one, the weight of which did not exceed five grains, it was a phosphatic calculus, smaller than a middle sized grain of coffee.*

The largest vesical calculus on record is said to have been in the possession of the French lithotomist, Morand. It weighed six pounds three ounces. An enormous stone weighing fifty-one ounces, was long preserved in the hospital of La Charité, Paris. It was extracted, after death, from the bladder of a poor curate, who died in that hospital, in the year 1690.

* Gross, l. c., p. 446.

The largest calculus preserved in our collections is the one which Mr. Cline attempted to extract from the bladder of Sir William Ogilvie; it weighed forty-four ounces, and was sixteen inches round one axis, by fourteen round the other. Numerous cases are recorded where the stone weighed from five to fifteen or twenty ounces; but how small a proportion they bear to the mass of cases operated on, may be gathered from the fact that, of the 703 calculi in the Norwich collection, weighed by Mr. Crosse, only two exceeded six ounces in weight, and they were between six and seven ounces.

The number of calculi existing at the same time in the bladder is subject to some variation. In the great majority of cases the calculus is solitary, but two or more may be found. Mr. Liston met with 7 out of 27 cases, in which more than 1 calculus existed. Klein met with 12 instances of 2 to 6 calculi in 79 operations. Mr. Crosse gives a list of 100 fatal cases of lithotomy, in 84 the calculi were single; in 7, 2 calculi were formed; in 6 cases, 3; in 2, 4 calculi; and in only 1 case, 5. Much greater numbers, however, have been extracted from the bladder; but it should be remembered that in such cases the calculi are small in proportion to their number. As many as 200 of these small calculi have been removed by Roux and Dupuytren. Sir A. Cooper extracted 242 at one time. My friend, Professor Eve, of the United States, removed 117 calculi by the lateral operation, weighing from one grain to three drachms. The case of a woman whose bladder contained 214 stones is recorded in the 'Philosophical Transactions.' It is stated that no

less than 59 calculi were discovered in the bladder of the celebrated naturalist, Buffon; and Murat affirms, what one is forced to consider fabulous, that he found 678 calculi in the bladder, and nearly 10,000 in the kidneys of an aged patient. An authentic case, however, and the most remarkable on record, occurred to the late Dr. Physick, of the United States, who extracted more than 1000 calculi from the bladder of Judge Marshall; they were of an oval shape, and varied from the size of a partridge shot to that of a bean.*

The internal structure discoverable on section is either uniform or formed of concentric laminæ encircling the nucleus. In many calculi, in addition to the concentric laminæ, lines radiating from the centre are observed, as if the laminæ were composed of perpendicular crystalline fibres. In some calculi the concentric laminæ are easily separable, in others firmly adherent. In the latter case the laminæ are sometimes, as in the oxalate of lime calculus, only indicated by faint concentric lines.

The chemical composition of the nucleus and concentric coats may be either homogeneous, or the nucleus may differ from the superimposed strata; these again may be severally composed of different constituents, as in the alternating calculus, so that each concentric lamina must be subjected to a separate analysis.

As the chief constituent of healthy urine is urea, so does uric acid constitute the nucleus in the great majority of urinary calculi. If, as is now generally ad-

* Gibson's Institutes, 5th edit., vol. ii, p. 220.

mitted, the phosphates be a product of irritation, and as Dr. Owen Rees asserts, oxalate of lime is to be regarded as uric acid, or urate altered after secretion, it would follow that calculous disease in the human race may be reduced to the deposit of a single element. "The other constituents," observes Dr. Rees, "are of such rare occurrence, that were it not for uric acid, calculus would be less frequently met with than tetanus."*

However this may be, the predominance of uric acid, as a nucleus, is fully established. Of 212 specimens in the Museum of Guy's Hospital, examined by Dr. G. Bird, 128 contained a nucleus of uric acid or urates. Of 71 calculi in the Museum of the Transylvania University, 44 were formed round nuclei of the urates or uric acid.

Of Dr. Bird's cases, the oxalate of lime and phosphates form the nuclei in 69 specimens—in the Transylvania Museum they constituted 22; hence, out of the whole number of 283 specimens, we have only 19 in which the nuclei were formed of cystine and by foreign bodies, where the calculi were mixed. Round the uric acid nucleus is often deposited a layer of oxalate of lime, which we can readily explain if we admit, with Prout and Dr. Rees, the conversion of uric into oxalic acid; while, still more superficially, are frequently discovered layers of the phosphates, evidently derived from irritation of the mucous membrane of the bladder.

The disposition of the nucleus is not always the same. It does not necessarily occupy the centre of the calcareous mass, nor is it invariably continuous with the

* L. c., p. 22.

layers which may have been deposited on it. Sometimes the nucleus is inclosed in a hollow envelope of calcareous matter, like a kernel in a nut-shell; the deposit and subsequent desiccation of animal matter, blood, &c., on the surface of the nucleus may possibly explain this curious circumstance. Mr. Crosse has given the figure of a stone, which resembled a small girkin in shape; the nucleus, composed of oxalate of lime, occupied one end, while the remainder was composed of the phosphates. In this case the calculus had been encysted, and the peculiar formation of the calculus probably depended on the fact that the nucleus was deposited in the cyst, while the phosphates were superadded from the cavity of the bladder into which the elongated part projected. In several cases the calculus has been found to contain two or even more nuclei; but from the descriptions given, it seems reasonable to conclude that for the most part they were distinct calculi, formed, perhaps, at different periods, and united together by phosphatic cement.

Sometimes the calculus is formed round a nucleus of blood or mucus, and this may perhaps explain the curious circumstance that calculi are occasionally hollow in the centre. The cavity, however, generally contains some pulverulent matter or small nuclei. A remarkable example of this kind was presented by Mr. Shaw to the Pathological Society. The calculus resembled in shape and size a small walnut, but was very light. On a section being made, the cause of this remarkable lightness became apparent. It was nearly hollow, the thickness of the shell varying from one-sixth to one-half of an inch.

Within the cavity was found lying loosely a small rugged calculus, about the size of a pea. The calculus, with its shell, was composed of uric acid.*

Several cases of the formation of calculi round mucus or clots of blood are recorded by Howship, Wilson, and others. The celebrated Frère Come made a fortunate guess in a case of this kind. Before proceeding to operate on the Archbishop of Paris, he announced that the stone enclosed a clot of blood, because the patient had been subject to hæmaturia for some time before the appearance of symptoms of stone. On examining the calculus after extraction, the predicted clot was found within it.

The nucleus may be formed by some foreign body accidentally introduced into the bladder. Almost every imaginable kind of substance has thus given origin to vesical calculus; and a detailed account of them would be more curious than useful. The foreign bodies are frequently introduced by accident, frequently also by design, especially in the case of females.

That the form of calculus is modified by its manner of growth, is apparent in many cases. A remarkable specimen was presented to the Pathological Society by Mr. James Salter, in 1854. The stone consisted of a central, oval mass, of uric acid, from which started three stalactite-like projections of the ammoniaco-magnesian phosphate. On examining the bladder, it was found that the uric acid nucleus had been lodged in an ulcer just behind the internal orifice of the urethra; and from

* Trans. of Path. Soc., vol. vi, p. 251.

this point the branches had passed into the three orifices of the bladder, the urethra and two ureters.*

The calcareous matter encrusting these foreign substances is usually composed of the phosphates, or the ammoniaco-magnesian phosphate; only one specimen in the college museum exhibits a coating with uric acid; the nucleus in this case was a piece of steel. M. Cloquet exhibited to the Academy of Medicine, Paris, an ivory pessary, one portion of which had penetrated into the bladder, and was encrusted with uric acid.†

Before giving an account of the chemical ingredients which enter into the composition of calculi, it may be well to notice the animal matter which is invariably present in them, and is supposod to bind their particles together, as by a cement. The nature of this animal matter has not been clearly determined, and it would appear to vary in different cases, being generally either mucus, fatty matter, or fibrin. It may, however, consist, in some part at least, of blood, pus, or epithelial scales. The mucous secretion of the bladder is the most obvious source, and to this Marcet referred the amimal matter of calculi; Fourcroy and Vauquelin considered it as consisting sometimes of albumen, sometimes of gelatine, with an admixture of urea. Berzelius was unable to determine whether it was composed of fibrin, albumen, caseous matter, or mucus; Brande says it is composed of a mixture of gelatine with urea.

Professor Scharling holds that the smaller nuclei are

* Trans. of Path. Soc., vol. v, p. 203.

† Lancet, Nov. 3, 1855, p. 417.

always enveloped by a layer of mucus, albumen, or some other organic matter, the flocculi of which entangle, and ultimately determine the crystallization of the more insoluble ingredients of the urine. Dr. Hoskins extends this view to the minutest particles of the concretion. On placing under the microscope a small quantity of calculous matter, imperfectly pulverized, and partly dissolved, he found that the particles were enveloped by a pellicle of transparent animal matter, and when this was completely divested of salt, it bore so great a resemblance to epithelial scales, as to be easily mistaken for them. Dr. Hoskins, also, frequently detected in the central parts of calculi, a large proportion of epithelial scales from the bladder and kidney, with fibrinous casts from the uriniferous tubes, and a peculiar fibriniform matter without any definite structure.*

The quantity of this animal matter has not been ascertained for the several species of calculi, and we can understand how it may vary according to several circumstances. Mr. Brande informs us that for uric acid calculi of the kidneys, the quantity of animal matter varies from a mere trace to two sevenths of the whole weight. Uric acid calculi in the bladder contain a much larger proportion. The oxalate of lime calculus contains a greater proportion than any other. It would also appear that the nucleus contains less than the outer layers; at least, in a phosphatic calculus examined by Morin, the nucleus contained only one tenth, while the shell contained seven tenths of animal matter.

* Gross, l. c., p. 457.

Finally, we must not overlook the observations made by Dr. Bence Jones, that all calculi, while retained in the bladder, are permeated by moisture. If this fact be established, it is of great importance in several points of view.

The chemical constituents of calculi may be conveniently divided into two classes, the first containing those which sometimes form entire calculi in a nearly pure state; the second, those which may be viewed as adventitious constituents.

A.—Forming entire Calculi or Laminæ.

1. Uric Acid.
2. Uric or Xanthic Oxide.
3. Urate of Ammonia.
4. Cystic Oxide, or Cystine.
5. Ammoniaco-Magnesian Phosphate.
6. Oxalate of Lime.
7. Phosphate of Lime.
8. Carbonate of Lime.
9. Mixed Phosphate of Lime, and Phosphate of Magnesia and Ammonia.

B.—Existing in small quantities associated with the preceding.

10. Urate of Potass.
11. „ Soda.
12. „ Lime.
13. „ Magnesia.
14. Organic matter, fat, extractive albumen, vesical mucus, blood.
15. Carbonate of Magnesia.
16. Silica.
17. Oxide of Iron (?)
18. Benzoate of Ammonia (?)
19. Oxalate of Ammonia (?)

20. Phosphate of Iron (?)
21. Hydrochlorate of Ammonia (?)
22. Urea (?)
23. Clay Mica (??)

The following table (p. 349), drawn up by Dr. Bence Jones, and copied, with some modifications, from a Lecture in the 'Medical Times,' Oct. 1851, affords at a glance, the mode of distinguishing the chemical composition of the principal species. The first proceeding in the examination of a calculus is exposure to a red heat, either by means of the blowpipe, or by placing a fragment of the calculus on a slip of platinum foil, and heating it in the flame of a spirit-lamp. The calculi formed of organic matter, including those of uric acid, urate of ammonia, cystine, xanthic oxide, and fibrine, swell, turn black, burn, and leave but a small residue of ash; whereas those consisting chiefly of inorganic matter, as the carbonate of lime, oxalate of lime, phosphate of lime, ammoniaco-magnesian phosphate, and the fusible calculus, are somewhat browned, evolving more or less of animal matter, which burns and leaves a large residue, often retaining the primitive form of the fragment.

If a blood-red colour be produced, when another fragment of a calculus of the first class is treated with nitric acid, and the solution cautiously evaporated to dryness, the calculus consists either of uric acid or of urate of ammonia; if the former, no odour of ammonia will be evolved by heating another fragment in liquor potassæ, or in a solution of carbonate of potass; if the latter, the odour of ammonia is very perceptible, and a white

cloud will be produced, when a rod moistened with nitric or hydrochloric acid is held over the liquids.

If no red colour be produced by the treatment of a combustible calculus with nitric acid in the manner already described, it consists of either cystine, xanthic oxide, or fibrine. If of cystic oxide, it readily dissolves in liquor ammoniæ, and crystals in the form of hexahedral plates or prisms are left after the spontaneous evaporation of the solution; if of xanthic oxide, it dissolves in liquor ammoniæ, but yields no crystals after evaporation of the solution; it dissolves in nitric acid without effervescence, and leaves a lemon-yellow residue; if formed of fibrine, it dissolves with difficulty in ammonia, yields no crystals by evaporation, and becomes yellow when heated with nitric acid.

If the calculus belong to the second division, and be not destructible by heat, it is either carbonate, oxalate, or phosphate of lime, or ammoniaco-magnesian phosphate; or the fusible calculus, a mixture of phosphate of lime and ammoniaco-magnesian phosphate. If it dissolve in hydrochloric and acetic acids with effervescence before the application of a red heat it is carbonate of lime. If it be soluble in hydrochloric but not in acetic acid, without effervescence before, but with effervescence after heating to redness, it is oxalate of lime; if it dissolve in hydrochloric acid, without effervescence either before or after exposure to a red heat, it may be either ammoniaco-magnesian phosphate, phosphate of lime, or the mixture of the two preceding salts. If the acid solution yield a white crystalline precipitate with excess of ammonia, and the calculus is rendered very fusible by the admixture of a small

quantity of phosphate of lime (bone earth) it is ammoniaco-magnesian phosphate; if excess of ammonia produce an amorphous precipitate, and the calculus is readily fused after, but not before the addition of some ammoniaco-magnesian phosphate, it consists of phosphate of lime; if, again, the acid solution yield a mixed crystalline and amorphous precipitate, with excess of ammonia, and the calculus is readily fusible, without any addition, it consists of the mixed phosphates, and is commonly designated as the fusible calculus.

These remarks will, I hope, render the following table readily intelligible.

Table for examining Urinary Calculi.

1. By Heat.	2. By Acids.	3. By Alkalies.	Nature of Calculus.	Additional Tests.
Destroyed by heat.	With nitric acid, red.	Soluble in carbonate of potash, evolving ammonia	Urate of ammonia	Soluble in water when boiled.
		Soluble in carbonate of potash, evolving no ammonia	Uric acid	Not soluble in water even boiled.
	With nitric acid, not red	In ammonia soluble, crystallizing when evaporated	Cystic oxide	Soluble in strong caustic potash; the solution gives sulphuret of lead.
		In ammonia soluble, not crystallizing when evaporated	Uric or xanthic acid.	Dissolves without effervescence in nitric acid, leaving a lemon-coloured residue; soluble in strong sulphuric acid, not precipitated by dilution.
		In ammonia with difficulty soluble, not crystallizing.	Fibrine	With nitric acid becomes yellow.
Not destroyed by heat.	With hydrochloric acid, soluble; before heat, effervesces.	Solution in acid, when neutralized, gives a white precipitate with carbonated alkalies & oxalate of ammonia.	Carbonate of lime	Soluble in dilute acetic acid, with effervescence.
	With hydrochloric acid. soluble; after heat, effervesces	Solution in acid, when neutralized, gives a white precipitate with carbonated alkalies & oxalate of ammonia.	Oxalate of lime	Insoluble in acetic acid. Decomposed by strong sulphuric acid, yielding carbonic acid and carbonic oxide.
	With hydrochloric acid, soluble without effervescence, or before or after heat.	Solution in acid, with excess of ammonia, gives a white crystalline precipitate	Phosphate of ammonia and magnesia.	With phosphate of lime (bone earth), is very fusible before the blowpipe.
		Solution in acid, with excess of ammonia, gives an amorphous white precipitate	Phosphate of lime.	With phosphate of magnesia and ammonia, is very fusible before the blowpipe.
		Solution in acid, with excess of ammonia, gives a white, partly crystalline, partly amorphous precipitate.	Mixed phosphates.	Easily fusible without addition before the blowpipe.

I now proceed to a more detailed description of the several recognised species of urinary calculi. These I have arranged in the following order; and in treating of each I shall explain the method of examining their chemical constituents:—

1. Uric or lithic acid.
2. Urate or lithate of ammonia.
3. Uric or xanthic oxide.
4. Oxalate of lime.
5. Phosphate of lime.
6. Phosphate of magnesia and ammonia.
7. Mixed phosphates, or fusible calculus.
8. Carbonate of lime.
9. Alternating calculus.
10. Cystine or cystic oxide.
11. Fibrinous calculus.
12. Prostatic calculi and concretions.

Uric Acid Calculus.—Uric acid is by far the most frequent constituent of urinary calculi, either alone or in combination with bases, as urate of ammonia, lime, &c. The calculi consisting of uric acid alone, or merely in a state of mixture with a small quantity of colouring matter, are more common than those of any other single constituent. The relative number of pure uric acid calculi in the Museum of the Royal College of Surgeons is one third of the whole collection; in that of St. Bartholomew's Hospital, 1 : $11\frac{8}{11}$; in Guy's Hospital, 1 : 5; in the Norwich Hospital, 1 : 4; in Swabia, 1 : $11\frac{4}{7}$; and in Copenhagen, 1 : 5. The general average deduced by Dr. Prout from these data is nearly 1 : $6\frac{1}{2}$.

The relative proportions of those composed chiefly of uric acid mixed with urate of ammonia, and of urate of ammonia with minute proportions of urate and oxalate of lime and phosphates is in St. Bartholomew's as 1 : 7; in Guy's Hospital, 1 : 4; in the Norwich Hospital, 1 : $1\frac{1}{4}$; in the Manchester Hospital, 1 : $2\frac{1}{2}$; in the Bristol Hospital, 1 : 3; in Swabia, 1 : 10; and in Copenhagen, 1 : $4\frac{1}{2}$; giving a general proportion of 1 : $3\frac{1}{2}$. If the calculi be included in which the nucleus is formed of lithic acid, we have the following as the proportions in these collections; in the Royal College of Surgeons, 1 : 1·4; in St. Bartholomew's Hospital, 1 : $1\frac{3}{4}$; in Guy's Hospital, 1 : 4; in the Norwich Hospital, 1 : $1\frac{1}{4}$; in the Manchester Hospital as 1 : $1\frac{3}{4}$; in Swabia, 1 : $1\frac{1}{6}$, and in Copenhagen 1 : $1\frac{1}{3}$ of the whole, the average proportion being 1 : $1\frac{1}{2}$. The proportion of calculi into which uric acid enters in larger or smaller proportions as one of the constituents in the collection of the College of Surgeons, is to the whole numbers as 1 : 1·36.

Of the 600 calculi examined by Fourcroy 500 were composed of uric acid; of 71 calculi preserved in the Museum of the Transylvania University, and analysed by Dr. Peter, 38 were formed on nuclei of urate of ammonia, and two on nuclei of uric acid.* Of 374 calculi in the Museum of Guy's Hospital, examined by Dr. Golding Bird, 269 showed nuclei consisting of uric acid or urates. In alluding to nuclei in another place I have mentioned the number of calculi examined

* Gross, l. c., p. 442.

by Dr. Bird as 212, but duplicate specimens were excluded from that estimate.

Two varieties of the uric acid calculus have been observed; the one consisting of those in which the uric acid is deposited in more or less distinct concentric layers, giving the section of the calculus a laminated appearance; the other variety in which the acid is deposited in a confused mass of crystalline amorphous grains; but these varieties are often mixed with or pass into each other.

The laminated uric acid calculus shows, on section, a series of concentric circles; a semi-crystalline and compact structure; a smooth surface, sometimes granular or even finely tuberculated, but if so the tubercles are smooth and polished. When broken it separates into angular fragments whose surface is fibrous, as if it were composed of crystalline fibres radiating from the centre to the circumference. The fracture occurs both in the direction of the radiating fibres and of the concentric layers. The fractured surface of the more compact calculi has a vitreous lustre.

The calculi in which no lamellæ are seen, either consist of an aggregation of large crystalline grains firmly adherent to each other, and presenting a radiated appearance, or they have a porous and earthy structure as if formed of loosely-cohering fibres. These calculi are less regular, have a rough surface, a granular and unsymmetrical fracture, and are most frequent in the kidneys. The nucleus of the laminated variety frequently presents this character. This form of calculus is more liable than the compact laminated variety to

spontaneous fracture in the bladder. Calculi are sometimes seen which present cracks in the direction of the radiating fibres, indicating that the manner in which this curious phenomenon occurs is probably produced by some unequal density in the deposits.

The colour of the uric acid calculus varies from pure white to a deep brownish red. The exact nature of the colouring matter, which exists only in a small proportion in the deepest coloured specimens, is altogether unknown, but it probably is of the same character as the colouring matter of the urine, so often seen in the crystals of uric acid and known as the red sand deposit.

There is another sub-variety of the uric acid calculus which is very common, especially in gouty persons. It is known as the pisiform calculus. This form is seldom solitary; many may exist at the same time in the bladder, and some may be voided by the urethra. These calculi are rarely larger than a common bean or large pea; they have an irregular angular shape produced by attrition against one another, are crystalline at the centre, laminated near the surface, and often coated with a thin layer of urate of ammonia.

The specific gravity of the uric acid calculus is usually from 1·5 to 1·786; but specimens have been observed in which the density was so low as 1·276.

Uric acid, when quite pure, is white, very sparingly soluble in water, one part of the acid requiring about 15,000 parts of cold and 1,932 parts of boiling water to bring it into solution, from which it is again deposited in the form of a granular powder composed of minute crystals of variable form, figured in the pre-

ceding description of the constituents of the urine. It is absolutely insoluble in alcohol or ether, but dissolves very readily in solutions of caustic potash or soda, especially when heated; in phosphate and biborate of soda, but not in solutions of the alkaline bicarbonates, and is precipitated from these solutions by acids. Nitric acid dissolves it with effervescence, the uric acid is decomposed, and equal volumes of carbonic acid and nitrogen are evolved. Sulphuric and hydrochloric acids do not affect it. When heated, it blackens and is gradually consumed, leaving no ash if perfectly pure. Uric acid is a feeble acid, but combines with bases and forms salts with them. The alkaline urates are sparingly soluble, but very much more so than the pure acid. Urate of potash dissolves in 140 parts of cold and 85 of boiling water, according to Liebig, but Berzelius states that it requires no less than 480 of cold water for solution. Urate of soda, which forms the gouty concretions known as chalk-stones, is much less soluble than the corresponding salt of potash, requiring 372 parts of cold and 124 parts of boiling water for solution. Urate of lime, small proportions of which exist in many calculi, forms shining white plates or needles, readily soluble in boiling water, but deposited from it as the solution cools.

Uric acid calculi are readily distinguished by a simple chemical analysis. When a fragment is heated to redness on a slip of metal, it blackens and gradually consumes, yielding hydrocyanate and carbonate of ammonia, and a small white ash remains, which is found to be pure lime produced by the presence of minute proportions of oxalate or urate of lime in the calculus.

When reduced to powder, and heated with liquor potassæ, the calculus readily dissolves, yielding a clear solution from which a white precipitate is thrown down by the addition of hydrochloric, nitric, or acetic acid. The precipitate is at first pulverulent, and very bulky, but on being allowed to stand in the solution for a short time it contracts very much in bulk and becomes granular. In this state, it is composed of minute crystals of uric acid readily discoverable by the microscope. It has been stated that uric acid calculi of moderate size, are dissolved in two days by an alkaline solution sufficiently weak to be borne in the mouth without inconvenience.

Another and striking test is the action of nitric acid on the calculus. A small portion of the powder is to be placed in a watch-glass or evaporating dish, and a few drops of nitric acid poured on it; it is then gently heated over a spirit lamp until the greater part of the acid is driven off, when the beautiful pink colour of the murexide is developed. This reaction is perfectly characteristic of uric acid.

The other substances found in uric acid calculi are animal matter, colouring matter, urate of lime, urate of ammonia, urate of soda, and traces of the inorganic salts of the urine.

Urate of Ammonia Calculus.—Calculi composed of unmixed urate of ammonia are comparatively rare on account of its solubility, forming only one in five hundred in the collection of the College of Surgeons, although this salt constitutes the nucleus of nearly one third of the whole in that collection. In Guy's Hos-

pital Museum there are but eight calculi entirely consisting of this substance, though it constitutes the nucleus in eighteen. This calculus was discovered by Fourcroy and Vauquelin in 1798, but its nature was more satisfactorily demonstrated by Dr. Prout in 1823. Calculi composed entirely of urate of ammonia seldom exceed an inch in diameter, are flattened, ovoid, smooth, of a brownish-grey or clay-colour, with frequently a tinge of green. These calculi are usually compact, earthy, and very brittle; they consist of thin consecutive layers so closely applied to each other as to appear homogeneous, but the laminæ are easily separated. They are almost peculiar to childhood, seldom if ever occurring after puberty, and their formation is accompanied by great constitutional disturbance and irritation. The calculi of children are almost invariably composed of this substance.

Urate of ammonia is a common deposit from urine when that fluid has an alkaline reaction, and usually carries down with it a greater or less proportion of colouring matter, which gives it a yellow or brown tinge. In a pure state this salt is perfectly white; it is much more soluble in water than uric acid; it requires, according to Liebig, 1727 parts of cold, and 243 of boiling water for solution; but the greater part of the salt is deposited on cooling in microscopic acicular crystals. The presence of chloride of sodium in the liquid, in the proportion of 2·5 to 1·000, enables it to take up more than double the quantity of the salt, and it is no longer deposited by cooling or evaporation in the rystalline, but in the peculiar amorphous condition in which it is ordinarily deposited from urine.

The calculus decrepitates when exposed to the blow-pipe, and consumes much in the same manner as the uric acid calculus; the remaining ash is, however, more copious, and consists either of pure lime or lime mixed with phosphates. The presence of ammonia is shown by heating a small quantity of the powder with liquor potassæ, when ammonia is disengaged in abundance, which may be detected by its odour, and by holding a rod moistened with hydrochloric acid over the liquid; or the ammonia may be determined by heating the calculus with hydrochloric acid, which combines with the ammonia, forming hydrochlorate of ammonia; this may be afterwards precipitated by bichloride of platinum, with the usual precautions. The uric acid is readily precipitated from the solution in caustic potash by either of the stronger acids.

On account of the more ready solubility of urate of ammonia, it may be separated from uric acid in cases where it exists in small proportions, by boiling the finely powdered calculus in water, pouring off the hot solution, and allowing it to cool, when the urate of ammonia is deposited either in small stellated crystals or in an amorphous condition. It is also soluble in alkaline bicarbonates, which is not the case with uric acid.

Urate of ammonia is often associated with oxalate of lime in calculi; in fact, the oxalate of lime diathesis is frequently preceded by a condition of the urine which favours the deposit of urate of ammonia, so that the nucleus is perhaps formed of urate of ammonia, while the succeeding layers are a mixture of these salts. These calculi often contain a small quantity of urate of

lime. The nucleus presents the character of urate of ammonia, decrepitating violently when heated, whereas the exterior layers are proved to contain both these salts by the tests already indicated for urate of ammonia, and those which will be given in the description of the oxalate of lime calculus. Urate of ammonia is also frequently associated with the earthy phosphates, either as a nucleus or in alternate layers or mixed in various proportions with the other constituents.

Xanthic or Uric Oxide Calculus.—This calculus is more rare than any other, only four specimens having been discovered. It was first described by Marcet, who ascertained the properties of this curious substance, which in composition differs from uric acid only in containing one equivalent of oxygen less than the acid. The specimen examined by Marcet no longer exists. Some minute specimens were examined by Laugier; but one calculus weighing 338 grains, and about the size of a small hen's egg was extracted by Langenbeck, and examined by Liebig; another is mentioned by Dulk. The Museum of Guy's Hospital possesses a fragment of the calculus extracted by Langenbeck.

These calculi are of a light or cinnamon-brown colour externally, and of a brownish flesh colour in the interior; their surface is smooth and polished; they are compact, but consist of concentric layers easily separable, without fibrous radiations or crystalline structure, and they assume a waxy lustre when rubbed or scraped. In point of hardness they resemble calculi of uric acid.

Uric or xanthic oxide is soluble in liquor potassæ, from which it is precipitated by acids as a white powder, which becomes light yellow by drying, and acquires a resinous lustre by gentle friction. It differs from uric acid by dissolving slowly without effervescence in nitric acid, and the solution, when evaporated to dryness, yields a residue of a brilliant lemon-yellow colour, partially soluble in water. This residue dissolves in liquid ammonia, forming a reddish-yellow solution. Mr. Taylor states that the same effects are produced when the xanthic oxide is mixed with a considerable proportion of uric acid; indeed its presence appears to prevent the formation of the pink colour produced by the successive action of nitric acid and ammonia on uric acid, changing the colour to a brick-red. Xanthic oxide and uric acid are equally soluble in strong sulphuric acid, but the latter is precipitated by the addition of water, while the former is retained in solution, and on this difference the process for separating these substances is founded.

After dilution of the sulphuric acid solution, the precipitated uric acid is separated, and the xanthic oxide may be removed by saturating with ammonia, evaporating to dryness, and dissolving the sulphate of ammonia with water. The solutions of xanthic oxide in caustic alkalies are not precipitated by hydrochlorate of ammonia, which throws down uric acid. Caustic alkalies and alkaline carbonates dissolve xanthic oxide, and it is more soluble in liquid ammonia than uric acid. Xanthic oxide gives out a peculiar odour when burned, differing from that emitted by uric acid or cystic oxide, and unlike uric acid, it yields no urea by destructive

distillation. By these characters this rare calculus may be distinguished from uric acid concretions, which it resembles very closely.

Oxalate of Lime Calculus.—Considerable discrepancy occurs in the relative numbers of these calculi in different collections. The proportion in the Museum of the College of Surgeons, where the entire calculus is composed of this salt, is as 1 : 20; in St. Bartholomew's, as 1 : 15; and in Guy's Hospital, as 1 : $14\frac{1}{2}$; but when those with a nucleus of urate of ammonia are included, the proportion is increased, in the collection of the College of Surgeons, to 1 : $3\frac{1}{2}$. If all the calculi be taken, in which oxalate of lime exists in any amount, then the proportion is, according to Dr. Prout, in the museum of St. Bartholomew's Hospital, 1 : $4\frac{3}{4}$; in Guy's, 1 : 4;* in Norwich, 1 : $7\frac{1}{2}$; Manchester, 1 : $4\frac{1}{6}$; Bristol, 1 : $3\frac{1}{3}$; Swabia, 1 : 27; and Copenhagen, 1 : $2\frac{1}{10}$. The average proportion in all these collections is 1 : $4\frac{1}{3}$.

It would seem, from the foregoing statements, that the oxalate of lime calculus is rarely pure, but associated with urate of ammonia, uric acid, urate and carbonate of lime, colouring matter, and blood.

The oxalate of lime calculus has been long known under the name of mulberry calculus, so called from the tuberculated surface it usually presents, which gives it somewhat the appearance of that fruit. This calculus has usually a rounded shape; its surface is dark brown

* In Guy's Hospital Museum the number of calculi containing more or less of oxalate of lime is 73 in 374, or 1 in $5\frac{1}{8}$. See Dr. G. Bird, Appendix, p. 447, &c.

or almost black. The internal structure, when exposed by section, is imperfectly lamellated, the consecutive layers forming waving lines, and its colour is such as to give the surface of the section a strong resemblance to knotted heart of oak, varying from white to bright yellow, yellowish-brown, or dark green. The structure is very compact and hard. The tubercles when divided appear to consist of stellate or acicular needles, arranged perpendicularly to the surface, and owing to the tendency of oxalate of lime to form nodular masses, it is by no means improbable that the whole calculus is made up of such nodules. Two other varieties of the oxalate of lime calculus exist; one of these is crystalline throughout, its surface studded with brilliant crystals of the oxalate in acute-angled octahedra, and these are nearly pure oxalate of lime.

The other form consists of small rounded masses, with a smooth polished surface, known as the hemp-seed calculi. These generally exist in considerable numbers. They are occasionally crystalline at the centre, and laminated towards the surface; but the laminæ are so fine as to give the section almost a compact appearance. They are composed of mixed oxalate and phosphate of lime in variable proportions.

The oxalate of lime calculus is distinguished from other calculi by swelling when heated on platinum foil, or in the blowpipe flame, and leaving a copious white ash, which is either caustic lime, or a mixture of quicklime and carbonate of lime, according to the intensity and duration of the heat; but usually the latter. This ash exhibits an alkaline reaction with moistened turmeric or reddened litmus paper, turning the former

brown, and restoring the blue colour of the litmus; it is soluble with effervescence in hydrochloric acid, and the solution gives no precipitate when saturated with ammonia, but a copious white deposit of oxalate of lime on the addition of oxalate of ammonia. The calculus itself is insoluble in acetic, but soluble with the aid of heat and pulverization in moderately strong nitric and hydrochloric acids, without effervescence, and the latter solution yields a white precipitate with excess of ammonia. Caustic potash has little or no action on this calculus, but when it is reduced to a fine powder, and boiled for some time with a solution of carbonate of potash, mutual decomposition ensues, and oxalate of potash and carbonate of lime are produced. If the liquid be then filtered, the carbonate of lime remains on the filter, which must be washed, and being heated to dull redness indicates the quantity of lime. Acetate of lead is now added to the pellucid solution until it ceases to give any further precipitate, oxalate with carbonate of lead are thrown down, collected on a filter, well washed, suspended in water, and a current of sulphuretted hydrogen passed through the liquid until the whole of the lead is converted into sulphuret; the liquid, again filtered and evaporated, yields crystals of pure oxalic acid. The true nature of these crystals is best ascertained by the microscope, under which they appear as beautifully formed transparent octahedra, with sharply defined edges and angles.

This calculus is distinguished from phosphate of lime or ammoniaco-magnesian phosphate by its insolubility in acetic and dilute hydrochloric acids, and the alkaline reaction of the ash on moistened turmeric paper. When oxalate of lime and phosphates exist in the same calculus

they may be separated by dissolving the calculus in strong hydrochloric acid, precipitating by ammonia, and digesting the residue in acetic acid, which dissolves the phosphates, but leaves the oxalate untouched. Acetic acid will separate the urate from the oxalate by dissolving the former.

Phosphate of Lime Calculus.—Calculi of pure phosphate of lime are rare. They were first described by Dr. Wollaston in the Philosophical Transactions for 1797. There are two varieties, the one evidently of renal, the other of vesical origin. Although entire calculi of pure phosphate of lime are uncommon, this substance is often found nearly pure in the laminæ of alternating calculi.

Calculi of phosphate of lime are stated by Dr. Prout to be in the ratio of 1 : 32¼ in the Museum of St. Bartholomew's Hospital; as 1 : 29 in Guy's; as 1 : 132⅗ in Norwich; and 1 : 155 in that of the Bristol Hospital. The general ratio of these calculi to others is as 1 : 117.

The calculi of renal origin are composed of the neutral phosphate of lime, those of vesical origin of phosphate of lime, similar to that of bones, and are thence often called "bone-earth calculi." The latter are more common than the former.

Calculi of neutral phosphate of lime are usually pale brown, with a smooth polished surface, regularly laminated, and the laminæ so slightly adherent as to be easily separable into concentric crusts. In some, radiating lines are seen in a direction perpendicular to the laminæ, as if the latter were composed of crystalline

fibres. These calculi contain a considerable proportion of animal matter, which is precipitated from the alkaline urine with the phosphate of lime. When heated before the blowpipe, or on platinum foil in the flame of the spirit-lamp, they char, give out the odour of burned feathers, and leave a white ash which fuses at a higher temperature into an opaque globule. They are soluble in hydrochloric and nitric acids, sparingly so in acetic acid, and the phosphate of lime is precipitated in a white gelatinous form by the addition of alkalies. Oxalate of ammonia throws down oxalate of lime when the solution is nearly or quite neutral. As the ammoniaco-magnesian phosphate is also readily fusible, it must be previously ascertained that none is present.

Bone-earth is said by Simon never to occur unmixed in the form of a calculus; but Dr. Taylor has described some specimens of vesical origin in the catalogue of the Museum of the College of Surgeons, as consisting entirely of this salt. These are in irregular masses resembling mortar, or a granular semi-crystalline powder, enveloped in a tenacious mucus. They are distinguished from the preceding by first charring, then leaving a bulky white ash which is infusible before the blowpipe.

Ammoniaco-Magnesian Phosphate Calculus. — This double salt, commonly known as the "triple phosphate," rarely forms an entire calculus, but is a very common constituent of other calculi, either mixed with phosphate of lime, as in the fusible calculus, or forming layers in alternating calculi. The proportion of calculi consisting of pure phosphate of magnesia and ammonia,

in the collection of St. Bartholomew's, is as 1 : 129; in Guy's, as 1 : 43½; in the Bristol Hospital, 1 : 218; in Copenhagen, 1 : 19½ Three calculi of this salt exist in the Museum of the College of Surgeons, which gives the proportion in that collection as 1 : 200. The general proportion in all the collections, excluding that of the College, is 1 : 126⅔. Ammoniaco-magnesian phosphate is a frequent deposit from alkalescent urine, or healthy urine which has been kept until rendered ammoniacal by decomposition of its urea. In such urine it is frequently deposited as a white brilliant crystalline powder, commonly designated *white sand;* but it is usually mixed with more or less phosphate of lime.

Calculi of ammoniaco-magnesian phosphate are generally white, uneven, and roughened by the projecting summits of the crystals, which are transparent and brilliant in the fresh state, but become opaque and lose their lustre after keeping for some time. They are either not laminated or imperfectly so, are friable, and easily reduced to powder. But occasionally they are hard, compact, and laminated; exhibiting a semi-transparent crystalline fracture, which gives them the aspect of alabaster. They sometimes attain a great size. Dr. Thompson mentions one which weighed nearly two pounds.

Two distinct salts are found in these calculi; one of them, the neutral phosphate of magnesia and ammonia, crystallizing, according to Wollaston, in rectangular prisms, the usual form being the triangular prism, terminated by three or six-sided pyramids, which forms a film on the surface, or is deposited in

urine that has become slightly alkalescent, or is thrown down by the addition of a small quantity of ammonia. The other, the bibasic phosphate, is deposited in stellated or foliated crystals, from strongly alkaline urine, or by adding a large excess of ammonia to healthy urine, and forms an iridescent pellicle on its surface, usually mixed with phosphate of lime. These salts do not exist naturally in the urine; they are formed by the combination of ammonia produced by the decomposition of urea with the phosphate of magnesia, present in greater or smaller proportion in all urine.

These calculi are recognised by giving off ammonia and watery vapour when heated in the blowpipe flame, leaving a large residue of phosphate of magnesia which fuses with difficulty into a white porous enamel. If a small quantity of phosphate of lime be added, the fusion is more easy and complete. They are readily soluble in dilute acids, including acetic acid, and the original salt is precipitated by ammonia as a white crystalline powder. When treated with caustic potash (liquor potassæ) ammonia is evolved.

Fusible Calculus.—The calculi commonly known by this name, consist of a mixture of phosphate of magnesia and ammonia, with phosphate of lime in very variable proportions.

These calculi bear a considerable proportion in all collections, being, in St. Bartholomew's, as 1 : 12 ; in Guy's, 1 : $3\frac{1}{2}$; in Norwich, as 1 : 19; in Manchester, 1 : $8\frac{1}{2}$; in Bristol, 1 : 12; in Swabia, 1 : $11\frac{1}{2}$; and in Copenhagen as 1 : $19\frac{1}{2}$; according to Prout. The relative number in the Museum of the College of

Surgeons, is 1 : 13½, while that in all the collections, excluding the College Museum, is 1 : 12¼.

Fusible calculi are white, grey, or dull yellow; they are more friable than any others, being sometimes so soft as to whiten the fingers like chalk when handled; these are not laminated. Others have distinct lamellæ with sparkling crystals of triple phosphate between them, which are so slightly adherent as to be readily separated; others again are composed of crystals aggregated into a confused mass. The calculi themselves are usually globular or ovoid, but sometimes very irregular in shape, being occasionally moulded to the cavity in which they are formed; they often attain a large size, and sometimes fill the whole cavity of the bladder; in this case impressions of the folds of the mucous membrane are visible on the surface, and when two or more exist in the bladder, they take a cubic or tetrahedral form. Excrescences composed of triple phosphate are sometimes found, resembling pearls in texture. The ammoniaco-magnesian phosphate is most abundant in those which have a shining crystalline texture, the phosphate of lime in the earthy and amorphous variety. The fusible calculus is found in all parts of the urinary organs, and in large cysts or cavities in the prostate gland.

The earthy phosphates are, according to Mr. Taylor, rarely succeeded by any other deposit; the only exceptions, that in the Museum of the College of Surgeons, being one in which layers of mixed phosphate exist in an oxalate of lime calculus, and one in St. Bartholomew's Hospital, in which a fusible calculus is surrounded by a layer of uric acid.

It would seem probable that the two ingredients of these calculi have a distinct origin; the ammoniaco-magnesian phosphate being derived from the urine, while the phosphate with a small proportion of carbonate of lime is secreted together with mucus by the irritated mucous membrane. This is exemplified very remarkably in calculi formed around a foreign body accidentally introduced into the bladder. The foreign body is first incrusted with phosphate and carbonate of lime derived from the mucous membrane of the bladder, and subsequently the irritation having extended to the kidneys the urine becomes alkaline, and ammoniaco-magnesian phosphate is deposited. In this case the layers near the nucleus contain more phosphate of lime than those near the surface, and when the calculus has been retained in one position, the greatest quantity of phosphate of lime is found on the side in contact with the mucous membrane of the bladder. If the urine be highly alkaline the mixed phosphates will be derived from this fluid, which may arise either from unnatural proneness of the urea to decomposition, or from long retention of urine in the bladder. As a secondary deposit the mixed phosphates are very common, few calculi remaining for a long period in the bladder without being incrusted with them. The uric acid calculus is least subject to this incrustation.

These calculi commonly contain urate of ammonia and animal matter often in considerable proportion, together with carbonate and urate of lime and uric acid.

The fusible calculus is characterised, as its nature implies, by giving off ammonia, and fusing readily be-

fore the blowpipe into a greyish-white transparent, or semi-opaque globule; and this when moistened does not yield an alkaline reaction with the turmeric paper, by which it is distinguished from the oxalate of lime calculus. The two chief constituents may be roughly separated, and their relative proportions estimated, by digesting a portion of the calculus previously reduced to fine powder with very dilute acetic or sulphuric acid, which dissolves the ammoniaco-magnesian phosphate, leaving the phosphate of lime untouched.

In a complete analysis of this calculus, fat and extractive matter must be first removed from the powdered calculus by ether and alcohol. The urates must be separated by repeated boiling in distilled water, in which they are soluble. The residue is next dissolved in hydrochloric acid, and if anything remain it is either uric acid or oxalate of lime. The uric acid may be separated from the oxalate by liquor potassæ, and the latter recognised by the tests I have already described under the head of oxalate of lime calculus.

If carbonate of lime be present, effervescence occurs during the solution of the calculus in hydrochloric acid. In this case the mixed phosphates are precipitated by ammonia, and to the filtered liquid oxalate of ammonia is added to throw down the lime. The precipitated phosphates are next digested in strong acetic acid, which dissolves the ammoniaco-magnesian phosphate with a small proportion of the phosphate of lime. The lime is first precipitated by oxalate of ammonia, and the phosphate of magnesia, as ammoniaco-magnesian phosphate, by ammonia. The animal matter, which resembles vesical mucus, is seen floating in the solution

of the calculus in hydrochloric acid, and may be separated by filtration.

These salts may be readily detected by dissolving a small fragment of the calculus in hydrochloric acid, precipitating by ammonia, and examining the precipitate under the microscope, when the triple phosphate is seen in the form of stellate crystals interspersed with the amorphous granular phosphate of lime.

Carbonate of Lime Calculus.—Calculi consisting of this salt, associated only with a small proportion of animal matter, are extremely rare in the human subject, but common in herbivorous animals, in whose concretions the carbonate of lime is usually mixed with carbonate of magnesia; but carbonate of lime is often found in variable proportion in the oxalate of lime and phosphatic calculi. Brugnatelli was the first to recognise this calculus: the specimen analysed by him was about the size of a pea, and contained some oxide of iron. Dr. Prout analysed some small calculi, consisting entirely of carbonate of lime which were white and friable. Mr. Smith, of Bristol, describes eighteen removed from the bladder of a young man, and Brugnatelli forty-eight from a similar source, and sixteen the size of a nut from a woman.

These calculi may be described as small—the largest not exceeding the size of a large almond, white or grey, but sometimes yellow, brown, or red, and the surface dusted over with a white powder. The concretion shows no concentric laminæ, but irregular waved lines similar to those in the mulberry calculus. The largest of the calculi in Mr. Smith's possession was so hard as to re-

quire the assistance of the lapidary's wheel to divide it, and was then capable of receiving a high polish. Others passed by the urethra of a rounded and flattened form, are compact, lamellar, and of a light brown colour. Carbonate of lime calculi are distinguished by dissolving with effervescence in dilute hydrochloric acid, the solution yielding no precipitate with pure ammonia, but a copious white precipitate of oxalate of lime when oxalate of ammonia is added, and also a white precipitate of carbonate of lime, by the addition of alkaline carbonates. If phosphate of lime be present in the calculus, it is precipitated from the solution in hydrochloric acid by ammonia.

Alternating Calculi. — A very large proportion of the calculi formed in the human urinary apparatus are of this character, owing to the successive changes in the condition of the system, and consequently of the urinary secretion. These calculi exhibit a series of alternating layers, differing in chemical composition. They may be composed of two layers: *e. g.* a calculus may have a nucleus of uric acid, covered by a deposit of urate of ammonia, oxalate of lime, phosphate of lime, or mixed phosphates; or the nucleus may consist of oxalate of lime, followed by uric acid, urate of ammonia, phosphate of lime or mixed phosphates. Other calculi have three layers; thus a nucleus of uric acid may be followed by deposit of oxalate of lime and mixed phosphates, or oxalate of lime and uric acid; or a nucleus of oxalate of lime may be covered by uric acid and urate of ammonia, or a nucleus of mixed phosphates followed by phosphate of lime and mixed

phosphates. Others, again, consist of four or even more layers: thus a nucleus of uric acid may be incrusted by urate of ammonia, uric acid, and urate of ammonia; or oxalate of lime be followed by uric acid, oxalate of lime, phosphate of lime, &c.

The proportion of alternating calculi of two layers to the whole collection, in St. Bartholomew's, is as 1 : $2\frac{1}{2}$; in Norwich, 1 : $2\frac{2}{3}$; in Manchester, 1 : $2\frac{5}{6}$; in Bristol, 1 : 3; in Swabia, 1 : $1\frac{1}{3}$; and in Copenhagen, as 1 : $2\frac{1}{2}$, giving a general proportion of 1 : $2\frac{2}{3}$.

Those of three deposits are, in St. Bartholomew's, as 1 : 6; in Norwich, 1 : 6; in Manchester, 1 : $26\frac{5}{7}$; in Copenhagen, 1 : $4\frac{1}{2}$; yielding a general average of 1: $8\frac{1}{3}$.

Those of four deposits are stated to be, in the Norwich collection, as 1 : $26\frac{1}{2}$.

The deduction to be drawn from all these data is, that alternating calculi of all kinds form somewhat more than half of the whole.

The order in which different deposits succeed each other in these calculi is of considerable interest, as elucidating the successive changes in the condition of the body, corresponding with the progress of the disease. Dr. Prout has calculated that oxalate of lime succeeds uric acid in the ratio of 1 : $15\frac{2}{3}$, whereas uric acid succeeds oxalate of lime in 1 : $13\frac{5}{23}$; so that the alternation of these two substances is nearly equal. He states that oxalate of lime follows urate of ammonia more frequently than uric acid, in the proportion of 1 : $9\frac{5}{8}$, whereas urate of ammonia follows oxalate of lime in 1 : 38. Phosphates succeed uric acid in the ratio of 1 : $9\frac{1}{6}$; the urate of ammonia, 1 : $12\frac{1}{2}$; and oxalate of lime, 1 : $7\frac{1}{2}$; whereas only three instances occur in the

museums already quoted in which phosphates are succeeded by uric acid or urate of ammonia; and oxalate of lime incrusts the phosphates only in the proportion of 1 : 253⅓. The general ratio in which phosphates succeed other deposits in all the collections is 1 : 4$\frac{1}{15}$. From these results Dr. Prout educes the law, that in urinary calculi, a decided deposition of the mixed phosphates is not followed by other deposits.

Cystic Oxide Calculus.—This calculus is very rare. It is found only in four museums mentioned by Dr. Prout in his work on urinary diseases, while the large collection of the College of Surgeons contains only three specimens. The general proportion is said to be about 1 in 304. In Dr. Golding Bird's analysis of the 374 calculi contained in Guy's Hospital museum, the number of cystic calculi is set down as 11. M. Civiale, in the course of his extensive practice, met with four examples.

Some years since, Dr. J. Risdon Bennett exhibited two specimens of cystic oxide calculi to the Pathological Society. They were taken from the kidneys of a female, one having been formed in each kidney, and were of considerable size. These calculi were surrounded by coagulated blood, and were of an irregular figure, being moulded to the shape of the distended infundibula of the kidney. The larger one measured two inches in length, and rather more than one in breadth at its larger extremity; its weight was 204 grains. Of a very irregular form, it closely resembled a piece of crystallized ginger, having a yellow smooth waxy appearance externally, and a crystalline character internally. The surface of one of its nodules was white, smooth, and

polished apparently from friction. The smaller calculus was of a similar irregular form, but differed considerably in its general aspect. It measured one inch and a half in length, and three quarters of an inch in breadth, and weighed 116 grains. Its external surface, blackened by dried blood, was rough, channeled, and presented the general appearance of being worm-eaten; it was of much less density than the larger one. It had, however, the same crystalline structure. Both calculi, on analysis, were found to consist of pure cystic oxide.

Dr. Handfield Jones exhibited another specimen of this calculus to the Harveian Society, in 1854. The patient, like the subject of Dr. Bennett's case, had been insane. The four calculi exhibited had come away spontaneously, with very little pain, and some small sand-like fragments were subsequently discharged. The calculi cut easily, and their surfaces had a waxy lustre; they presented under the microscope crystalline prisms of various sizes, generally much elongated and mixed with rather fatty epithelial scales. Ammonia dissolved the calculus completely, leaving, on evaporation, hexagonal plates and elongated prisms.

It is remarkable that the disposition to the formation of these calculi appears to be hereditary. Out of 22 cases, 10 occurred in four families, and in 3 cases the subjects of the complaint were brothers.

The term cystic oxide is a misnomer, since this substance is a product of the kidneys, and not of the bladder. Nor is it peculiar to the human body, a calculus of this kind having been found in the bladder of a dog.

Cystic oxide calculi are usually small, rounded, of

a yellowish colour, with a smooth, semi-transparent and glistening surface. They resemble those composed of ammoniaco-magnesian phosphate in general appearance, but are more compact in structure. They have a soft consistence, the section is confusedly crystalline, and not laminated. The fracture exhibits a crystalline structure. The largest known calculus of this substance is in the museum of University College, London, which weighs 850 grains, and is formed of concentric semi-crystalline layers. Another specimen, weighing 740 grains, is in the museum of St. Bartholomew's Hospital. They are said by Dr. Golding Bird to undergo a change of colour from yellowish brown to a fine bluish-green when long kept.

Cystic oxide is not unfrequently found as a deposit in the urine, which then has a greenish-yellow appearance, a disagreeable odour, a neutral or slightly acid reaction. It rapidly becomes alkaline, and deposits cystic oxide, or an oily film forms on the surface, consisting of cystic oxide mixed usually with ammoniaco-magnesian phosphate, and at the same time uric acid and urea are more or less deficient in quantity. Dr. Golding Bird obtained ·340 of a grain from 1000 grains of urine of sp. gr. 1·014.

Cystic oxide or cystine is remarkable for its solubility in a large number of menstrua. It is alike soluble in the mineral acids and in the caustic alkalies, and the solutions yield colourless granular crystals by spontaneous evaporation. It is sparingly soluble in pure water, and insoluble in alcohol, acetic, tartaric, and citric acids, and in solution of bicarbonate of ammonia. During the evaporation of the solution in caustic ammonia, the

ammonia escapes, the crystals of pure cystine are deposited either as hexahedral prisms or plates. From its alkaline solutions it is precipitated by acetic acid in the form of a white crystalline powder. Cystic oxide is remarkable for containing 26·58 per cent. of sulphur, and it was ascertained that the large calculus in University College yielded 19 per cent. of this substance. When heated cautiously on platinum foil it is surrounded by a blue flame, which disappears on the application of a stronger heat, and at the same time it gives out a peculiarly disgusting odour.

These calculi are distinguished from all others, except those of uric oxide, by their ready solubility in acids and alkalies, especially by dissolving readily in liquid ammonia. They are best distinguished by dissolving a fragment in liquor ammoniæ, and allowing the solution to evaporate spontaneously on a slip of glass. The residue, examined by the microscope, is found to consist of minute six-sided tables or prisms, characteristic of cystic oxide. The peculiar nauseous odour when burned is also diagnostic of this calculus. It is distinguished from uric (xanthic) oxide by its solubility in carbonate of potash and dilute hydrochloric acid, and from uric acid by its solubility in dilute hydrochloric, phosphoric, and oxalic acids. Liebig has given a very characteristic test for this substance, depending on the presence of sulphur. He directs it to be dissolved in a strong solution of caustic potash, and a solution of acetate of lead added as long as no oxide of lead is deposited. The mixture is then boiled, the cystic oxide is decomposed, ammonia is disengaged, sulphuret of lead is deposited, giving a black colour to the liquid, and after filtration oxalic acid

is found in the clear solution; but, as Dr. Golding Bird observes, this test is fallacious if any albuminous or mucous substances or bile are mixed with the deposit.

Cystic oxide calculi are usually free from admixture of other substances, but uric acid sometimes forms the nucleus, and a layer of uric acid has been found surrounding a nucleus of cystic oxide. It is also occasionally associated with ammoniaco-magnesian phosphate and carbonate of magnesia.

Silicious Concretions.

Although, as Dr. Golding Bird informs us, silicic acid has been found in crystals, forming part of a calcareous concretion, I am not aware that any calculus has ever been discovered, into the composition of which silicic acid enters to any considerable degree. The cases on record of silicious pebbles being extracted from the bladder, admit of being explained in a simple manner. The foreign bodies were introduced into, not formed in the bladder. I have related a curious example of this kind in my work on "Lithotrity and Lithotomy." A female was supposed to labour under calculus; I was about to attempt Lithotrity, when I found that the foreign body could be removed by dilatation of the urethra. This was effected, and the supposed calculus turned out to be a silicious pebble, which the woman had slipped into her bladder.

Fibrinous Calculus.—This rare calculus was first recognised and described by Dr. Marcet. Dr. Prout states that he has seen several specimens, but none are

enumerated in the collections to which I have repeatedly referred. Their relative frequency is therefore unknown.

Fibrinous calculi are described by Dr. Prout as being usually of an amber colour and waxy consistence, with more or less of a fibrous texture. They are, when unmixed, wholly combustible, giving out an odour of burnt horn, and leaving only a small quantity of ash; insoluble in water, alcohol, or ether, but soluble in caustic potash, from which a precipitate is thrown down by hydrochloric acid. They are soluble in acetic acid, and ferrocyanide of potassium produces a white precipitate in the solution. Nitric acid slowly dissolves these calculi. Dr. Prout asserts that they really consist of fibrine, while others consider that they are formed of vesical mucus or albumen.

Prostatic calculi and concretions will be described with other affections of the prostate gland.

CHAPTER XVII.

CAUSES OF STONE.

The importance of acquiring a knowledge of the causes of urinary calculi must be apparent to every one who considers that it affords the only means by which we can prevent the occurrence of this most painful disease, as well as its recurrence after the sufferings and hazards of an operation.

In former times, the causes and mode of formation of calculi in the bladder were very imperfectly understood; but much has been done of late to elucidate these subjects by an extended knowledge of the chemical constituents of the urine, of the concretions which form in it, and the changes which take place during respiration and digestion. Much, however, remains to be done, before a complete account of the etiology of calculous complaints can be given.

The great principle on which the formation of calculi depends is the saturation of the urine with some sparingly soluble substance, which is capable of concreting into a solid mass either by itself or with the addition of an animal cement. The precipitation and

agglomeration of the calcareous principles are physical phenomena; but vital acts likewise concur, by producing the precipitable matter in excess, and also by furnishing the animal substances which serve to bind its particles together.

In endeavouring to trace the formation of calculi to their causes, the following method appears the most logical, and in pursuing it we may inquire, What are the sparingly soluble substances which enter into the formation of urinary calculi? Whence is the excess of insoluble matter derived? What are the circumstances which promote or determine its precipitation from the urine? And lastly, By what means, or under what circumstances is it collected into a mass so as to form a stone? If we omit from consideration the few cases in which the stone is formed of cystic oxide, uric oxide, or carbonate of lime, it will be found that all the remaining species of calculi are composed of uric acid or urates, the earthy phosphates, or oxalate of lime. These are the three sparingly soluble substances the agglomeration of which forms urinary calculi.

The great majority of urinary calculi is composed of uric acid or the urate of ammonia. Uric acid is a constituent of healthy urine in which it exists under the form of urate of ammonia, or, as some chemists hold, of urate of soda. About eight grains of this substance are daily excreted with the urine during a state of health; urine likewise contains the well-known substance urea, which resembles uric acid in composition, but on account of its solubility never is precipitated to form a stone. About half an ounce of urea is separated daily from the blood by the kidneys.

The composition of Urea is . .	$C_2\ N_2\ H_4\ O_2$
That of Uric Acid is . . .	$C_{10}\ N_4\ H_4\ O_6$

The principal difference is made up by carbon and oxygen, the elements of carbonic acid, and this leads us at once to refer excess of uric acid to some defect in that process by which carbonic acid is produced; viz., the function of respiration.

The principal facts connected with this part of the subject relate to the doctrine of the metamorphosis of living tissues, through the agency of oxygen. Those who are familiar with the doctrines of Liebig will understand how the principal elements of our food are converted into the textures of the living body; how certain elements go to form muscle, and how the waste of this muscle passes off by the urine. During the combustion which takes place in the lungs, oxygen combines with the carbonaceous element, and carbonic acid is expired; oxygen also combines with the hydrogen, and the resulting water is thrown off by the lungs and skin; finally, acting on the nitrogenous elements which abound in flesh, the oxygen gives rise to the formation of urea and uric acid, which pass off by the kidneys. In all these changes, oxygen is the reducing principle, and it seems well established that according to the free supply of oxygen, or in other words, according to the activity of the respiration, so is the nature of the nitrogenous product determined. When respiration is active, the quantity of carbonic acid expired is great, and hence the residual quantities of carbon and oxygen are proportionably small; the product is, there-

fore, urea, which contains only two equivalents of carbon and oxygen. On the other hand, when the respiration is inactive, when little oxygen is consumed, the residual quantities of carbon and oxygen are great and the product is uric acid, containing ten equivalents of carbon to six of oxygen. In the transformation of tissues, then, the nitrogenous elements which are subsequently removed by the kidneys, exist in the form of uric acid, which is converted by the action of oxygen into urea. From these facts it might justly be inferred that as often as the respiratory function is defectively performed the urine should contain an undue proportion of uric acid, giving rise to the saturation with a sparingly soluble substance, and this corresponds with the history of the circumstances under which calculous disorders most frequently occur. We find all authorities agreed in describing imperfect respiration, from whatever cause it may arise, as one of the most striking conditions concerned in the production of urinary calculi.

There is, however, another way in which the proportion of urea and uric acid may be increased. In the cases just alluded to there is a tendency to the formation of uric acid rather than of urea from the used up elements of the body; but in other cases the amount of urea is directly augmented by an excess of nitrogenous food; respiration, however active, can produce a certain amount of urea only, and the excess of nitrogen appears in a superabundance of uric acid. Taking together the two causes, it may be said that nitrogenous food increases the proportion of urea, while oxygen diminishes that of uric acid; but as the latter, in all probability, is only a transition substance, the

proportion of the two elements cannot vary independently of each other.

When the supply of nitrogenous food exceeds the natural wants of the body, an excess of nitrogen beyond that required for muscle, &c., remains in the stomach; thence it passes into the blood, forms urea, and is excreted by various channels, but chiefly by the kidneys. Liebig has attempted to deny the connection between rich living and the tendency to urinary calculus. He holds that uric acid can only be derived from the living tissues, and that a superabundance of this substance can only arise from the rapid metamorphosis of these tissues, as under muscular exertion or the excitement of fever.

This, however, is rendering experience subordinate to theory. It accords with Liebig's theory of the formation of urea; but whatever theories we may adopt, it is certain that the amount of urea in the blood is increased by rich diet and an inactive mode of life. I shall enter more fully into this part of the question when speaking of the influence of diet as a cause of stone. For the present I may refer to the researches of Magendie and Chossat, which well illustrate the opinion that has so long prevailed as to the connection between an over rich diet and the production of calculus. Were we to adopt Liebig's views, we should be obliged to deny the alliance between gout and full living, as well as between generous food and stone; since gout is manifestly connected in some measure with an excessive formation of uric acid.

The experiments of Lehmann, moreover, seem to set the question at rest. This eminent physician, experimenting on his own person, found that when he lived on a strictly animal diet the quantity of urea excreted

amounted to 819 grains, while on a wholly vegetable diet the amount in the same period was reduced to 346 grains. Hence, if we take the quantity of urea resulting from the waste of tissues at 240 grains, it appears that an excess of urea, amounting to 580 grains daily, may be produced by diet.

I have thus endeavoured to explain the manner in which an excess of the precipitable matter is produced. Without adopting the secondary theories, we can conceive how an excess of animal food may give rise to an excess of nitrogenous compounds, and how imperfect respiration may fail to convert these compounds into the more soluble urea.

My next step will be to inquire in what manner and under what circumstances the excess of sparingly soluble substance is precipitated from the urine. Precipitation occurs either from a disproportion between the quantities of the substance and its watery menstruum, or because the solvent properties of the menstruum have been altered by the presence or absence of some other substance.

The matters precipitated to form calculi are urate of ammonia and uric acid. If the latter substance existed as such in urine, its precipitation would be easily accounted for by the insoluble nature of the acid; but it has been ascertained that uric acid exists in the urine under the form of urate of ammonia, or urate of soda. According to Dr. Golding Bird, the uric acid, at the moment of its separation from the blood, comes into contact with the double phosphate of ammonia and soda derived from the food; it combines with the ammonia, and sets free the phosphoric acid. Up to a certain point, and while the proportion between the urate of

ammonia, and the bulk of the urine is not much altered, no deposit of urate takes place; if an excess of uric acid be separated by the kidneys, crystals of uric acid are thrown down. This points to one source of the deposit of uric acid; but it is obvious that the acid may likewise be derived from decomposition of the urate of ammonia, and this would appear to be its ordinary source. In what manner, then, and by what reagent, is the decomposition of the urate of ammonia effected?

To answer these questions satisfactorily, we must consider the acid and alkaline conditions of the urine, and likewise examine what takes place in the stomach during the process of digestion.

Most chemists concur in opinion that an acid condition of the urine promotes, or, at all events, coexists with the deposit of uric acid. There is some difference of opinion, however, as to the nature of the acid which gives urine its acid reaction. Berzelius thought it was due to the presence of lactic acid; Dr. Prout attributed it to the acid urate of ammonia; Dr. Bence Jones, without coming to any decided opinion, is yet inclined to think that the acid character of urine depends on the presence of the acid phosphate of soda. Dr. Golding Bird and Liebig attribute it to the phosphoric acid set free during the combination of uric acid with ammonia, as already noticed; and this opinion has been very generally adopted. However this may be, it seems well established that the solvent powers of the urine are greatly modified according to its acid or alkaline character. According to Dr. B. Jones, indeed, the precipitation of uric acid crystals depends solely on the acidity of

the urine, or, in other words, on a deficiency of alkali in that fluid. The same holds good with respect to urate of ammonia. The less acid the urine is the more urate it holds in solution; a slight degree of acidity throws down the urate, a greater degree precipitates uric acid. We are not, however, to conclude that it is the same acid which acidifies the urine and throws down the uric acid. The two circumstances may be coincident without acting in relation of cause and effect. For the precipitating agent we have to look to the stomach and alimentary canal. Experiments have shown a close affinity between the acid conditions of the stomach and bladder; the one organ influences the other in a very remarkable degree; but long before these experiments were instituted, the connection between the presence of a free acid in the system and the formation of uric acid deposits had been observed. In tracing this connection, we should consider the process of digestion, examine on what the acidity of the stomach depends, and follow the products of disordered digestion from the stomach to the blood, and from the blood to the urinary reservoir. Without going so far, it may suffice to state a few facts which appear sufficiently established. The acid state of the stomach probably depends on the presence of hydrochloric acid; when this arrives in the urinary organs, it combines with the ammonia, and sets free the uric acid of the urate of ammonia. From experiments performed out of the body, it would appear that hydrochloric acid must remain for a considerable time in contact with the urate of ammonia, before uric acid crystals are thrown down. This explains how we so often escape the effects of indigestion, and also helps to

account, independently of ammoniacal decomposition, for the tendency of urine to deposit its solid materials, when retained for a long time in the bladder.

I have now arrived at the third stage of the formation of calculi. The excess of the insoluble material has been accounted for, and the chief causes of its precipitation have been briefly pointed out. But the combined action of these causes would produce gravel, not calculus; I have still to explain in what manner the crystals of uric acid and the amorphous deposit of urate of ammonia are collected and bound together, so as to form a solid mass of stone.

In describing the nature of the various substances found in calculi, I directed attention to the animal matter, mucus, epithelial scales, fibrin, &c., which are mixed up with the particles, and appear to pervade the whole substance of the calculous mass. Dr. Hoskins found a pellicle of this animal matter enveloping the particles of stone, even when reduced to powder. The natural mucus of the bladder may therefore form the bond of union between the calculous particles; and it is known that the mucus becomes exceedingly glutinous in certain diseased conditions of the vesical mucous membrane, or of the system in general. In vesical catarrh, for example, the mucus often becomes adhesive and stringy. The agglomeration of the particles by this adhesive mucus is thus readily understood, and the presence of an unorganized nidus may favour the tendency to deposit, for we know that urate of soda in gouty persons will crystallize in the unorganized cartilage, while it avoids those tissues which are furnished with blood-vessels.

The deposit of calculous matter around foreign bodies in the bladder probably belongs to another order of phenomena, which I shall presently notice.

To explain the formation of a calculus, particularly of a homogeneous calculus of any considerable size, it is necessary to suppose, not only that the saturation of the urine just referred to should occur, but that it should have a certain degree of persistence through a long period of time.

Again, to account for the alternation of layers of different kinds of substance, we must suppose that at intervals the substance with which the urine is saturated changes—that a new diathesis arises for a time. This change may sometimes be the effect of the medical treatment employed to counteract the morbid character which had been first observed in the urine; at other times it has been conjectured to be the result of a temporary alteration of the urine, owing to the change in the secretion of the mucous membrane by the irritation which the calculus has produced. It must be confessed, however, that on this subject the explanations are not satisfactory.

Although certain general laws are applicable to the formation of all calculi, I have thought it right to consider separately the oxalate of lime and phosphatic formations. The circumstances under which these substances are produced seem to justify this arrangement.

The oxalate of lime deposit is peculiarly interesting to the surgeon, from its forming the well-known mulberry calculus; while in a medical point of view it is highly important to determine the circumstances which

promote its deposit. Oxalate of lime is not a constituent of healthy urine. How then is this new substance produced? Dr. Prout was convinced that the oxalic acid was one of the results of imperfect digestion, and that it was derived from vegetable food, more particularly such as contained sugar. Liebig has propounded a very different theory; viz., that it arises from the imperfect oxidation of uric acid during the metamorphosis of the living tissues. If the supply of oxygen fails to a certain extent, the products of combustion in the lungs are urea, oxalic acid, and the substance called alantoin. In confirmation of this view, Dr. Bence Jones remarks that oxalic acid occurs in the urine where no vegetable food has been taken, and that uric acid sediments with oxalate of lime occur constantly in the same kind of cases at the same time, or rapidly alternate with each other.

Dr. Owen Rees* has recently put forward a theory which has, at all events, the merits of simplifying the question considerably. According to Dr. Rees, oxalic acid and the oxalate of lime are produced after the urine has been secreted by the kidneys, and are artificially derived from uric acid or the urates. The close relation between uric and oxalic acids has been long known; the urate of ammonia contained in guano is frequently converted into oxalate of ammonia during the voyage home, and we can readily believe that a similar conversion may take place in the urine.

But the question arises whether oxalic acid and its compounds be produced from uric acid and the urates in

* Croonian Lectures, Longman and Co., London, 1856.

the blood, as Liebig believes, or whether the change be affected in the urine after its secretion by the kidney. Dr. Rees holds the latter opinion, in support of which he adduces the following reasons. Oxalate of lime, it has been said, sometimes exists in the blood; but Dr. Rees thinks it highly improbable that it is an educt of analysis, because heat was employed, and heat converts the uric acid or urate, more or less completely, into an oxalate.

In many cases, the presence of oxalate of lime was demonstrated by applying a gentle heat to urine containing a full deposit of the urates, and then subjecting the deposit obtained to microscopic examination; but, according to Dr. Rees, there is no evidence to show that the oxalate of lime was originally present in these cases, while the employment of heat would sufficiently account for its appearance.

In other cases, however, the oxalate of lime has been found unmixed with the urates. Here the same explanation may be given, the uric was converted into oxalic acid by the mode of analysis employed. In confirmation of these views, Lehmann observed that morning urine, after standing some hours, often contains oxalate of lime in quantity, although the fresh urine did not afford any trace of it; while Wöhler and Frerichs found that the urates, when injected into the blood, produced oxalate of lime in the urine. Finally, Dr. Rees holds that there is no peculiar pathological condition connected with the oxalic diathesis, but that the latter is an accidental and unimportant modification of the uric acid diathesis. From the preceding remarks, it will be observed that, on Dr. Rees's theory, the

oxalate of lime calculus is formed by decomposition of uric acid, or an urate in the kidneys or bladder; these are converted into oxalic acid, which unites with the lime, but we are not informed on what the conversion depends; we are allowed to infer that it may result from heat. If this be the case, it would be important to determine what degree of heat is required for the conversion of uric into oxalic acid.

The phosphates, alkaline urine, and the phosphatic diathesis next demand attention.

Two kinds of phosphates, the alkaline and earthy, are found in urine. The alkaline phosphates are soluble, and therefore never form deposits or concretions; the earthy phosphates, as the triple phosphate, the alternating deposits, &c., on the contrary, are often thrown down, and concrete into solid masses. Though to a certain extent soluble, the solubility of the earthy phosphates is greatly modified by an acid condition of the urine. The more acid the urine, the more of the earthy phosphates does it hold in solution, and if we neutralize the acidity by the addition either of a fixed or volatile alkali, the earthy phosphates are thrown down. Such is the effect produced out of the body, and we naturally inquire how far a similar effect may take place in the bladder.

The urine is naturally acid, but it may become alkaline from excess of a volatile or of fixed alkali, and it would appear, according to the opinions most generally received, that the excess of each kind of alkali may be traced to a state of the system corresponding with its own kind, but very different from the other. The volatile alkali contained in urine is carbonate of ammonia. We have no proof whatever that this substance is contained

in or derived from the bladder. Whence then is it derived? The observation of a simple fact will assist us in answering the question. If healthy urine be allowed to stand for some time, it loses its acid character, and becomes alkaline from the development of the volatile alkali; the urea is converted into carbonate of ammonia, a substance closely related to it, and the change is probably effected through the instrumentality of a ferment, because we can convert urea into the volatile alkali by the action of yeast or a decomposing animal matter.

The same agent, viz., mucus altered by an unhealthy condition of the secreting membrane, may effect the conversion of urea into an alkali in the bladder. The influence of the mucus can indeed be directly proved by experiment; on removing it carefully by means of a filter, the conversion of urea into carbonate of ammonia is retarded by several days.

The urine, again, may be alkaline from the presence of a fixed alkali, which is commonly the phosphate of soda. The presence of this compound may be accounted for in the following manner: during the process of digestion a quantity of acid is liberated in the stomach, and a corresponding quantity of alkali is set free in the blood; the alkali is for the most part soda; arrived at the bladder, the soda meets the phosphoric acid, liberated by the action of uric acid, or the phosphate of ammonia and phosphate of soda is produced.

Sometimes the alkaline carbonates are produced, but much more rarely. From whatever cause the urine is rendered alkaline, any diminution of its acidity, or, what comes to the same thing, any addition to its alkaline

condition, produces a tendency to the deposit of the alkaline phosphates. According to these views, ammonia, and the deposit containing ammonia, depend on a diseased or inflamed condition of the mucous membrane; while the earthy phosphates are connected with a disordered state of the stomach and digestive organs.

Dr. Owen Rees,* in the publication already noticed, and on many occasions antecedent to it, has generalised the doctrine of mucous irritation, and maintains that the formation of the earthy phosphates as constituents of urinary calculi, is entirely an effect of the mechanical action of other calculous matters. These substances, acting as foreign bodies, irritate or influence the mucous membrane of the bladder, or, in a few cases, the membrane becomes diseased, independently of a calculous nucleus. Under the influence of this diseased condition, the mucous membrane of the bladder or kidney secretes a quantity of alkaline fluid, which comes in contact with the earthy phosphates, and causes their precipitation. The admixture, then, of the urine with the alkaline fluid secreted by the mucous membrane of the urinary passages and bladder, is the cause of alkaline urine and phosphatic deposit in the great majority of cases which come under treatment.

Dr. Rees does not adopt the theory of fermentation and liberation of ammonia, already noticed, for two reasons. The mucous membrane changes acid urine into alkaline immediately, whereas time would be required to effect fermentation; and, secondly, the ammonia is pro-

* L. c., page 24.

duced, not by fermentation, but by the decomposition of the ammoniacal salts of the urine through the agency of the fixed alkali secreted by the mucous membrane. In confirmation of these views, Dr. Rees alludes to a highly interesting case of extro-versio vesicæ, which came under his notice several years ago. The mucous membrane of the bladder was red and inflamed, and an alkaline urine was constantly discharged from its surface. The urine, however, was distinctly acid, as it flowed from the orifices of the ureters; it had become alkaline after having passed over a quarter of an inch only of the diseased mucous membrane.

From the above it will be seen that Dr. Rees does not acknowledge the formation of earthy phosphates by secretion from the mucous membrane, yet it seems highly probable that such an effect may arise from irritation of the mucous membrane of the bladder; other mucous membranes are capable of secreting the phosphates of lime and magnesia. Thus a wax bougie, which had been introduced into the vagina, was found covered with a layer of phosphate of lime and magnesia, and a concretion formed of adipocere and crystals of phosphate of lime has been found in the uterus.

From the condensed history which I have thus given of the formation of urinary calculi, it will be seen that modern researches have greatly tended to simplify the subject, without, however, solving it in all its relations. I have pointed out the sources of the sparingly soluble substance, and shown that in the great majority of cases it is derived from errors of nutrition, and imperfect respiration; I have endeavoured to explain under what circumstances the excess of

material is precipitated, and have shown that an altered mucus, acting as a cement, binds into a calculous mass the precipitated particles. This is the most general view that can be taken; but some theories may be noticed in detail.

Von Walther regards urinary calculi as holding a middle place between crystals of a purely chemical character and organic growths; partaking, as he says, more largely of the latter than of the former character. He considers deposits thrown down from the urine owing to its mere saturation to form solely sand and gravel; and that true calculous concretions do not form except when there occurs a certain degree of inflammatory action in the urinary passages, and a peculiar chemical change in the constituents of the urine which enter into them. Thus, he affirms that the oxidation of uric acid is a necessary preliminary to its transition into a true calculus; and that the secretion from the lining membrane of the urinary passages is also requisite to form an agglutinating matter. Further, he assumes that the successive oxidation of the uric acid is accompanied with a relative want of oxygen, and that an excess of nitrogen determines to the formation of the uric acid calculi; while a defect of nitrogen determines to the formation of the oxalate of lime concretion. He informs us that ammoniaco-magnesian phosphate is the only one of the ordinary constituents of calculi which exhibits signs of crystallization; and he ascribes this and the deposition of phosphate of lime, which commonly occurs on the outer surface of calculi, to their being simply chemical deposits from the urine, determined by the previous presence of solid bodies in the bladder.

Thus these phosphatic concretions approach, according to Von Walther, to the character of simple incrustations, such as, he says, take place on foreign bodies. It is a part of this view, then, that while ordinary calculi participate in the character of organic growths, incrustations such as those referred to are simply chemical deposits.

The objections to these views arise from their hypothetical character. Wetzlar strongly controverts these opinions, affirming that urinary calculi are in no respect organic bodies, and that the supposed changes in the uric acid, and in the membrane of the urinary passages, are entirely hypothetical. Wetzlar, however, has gone perhaps into the opposite extreme; he maintains that the free state of uric acid in the urine is unnatural, conceiving that in its ordinary state it exists combined with soda, thus adopting a view akin to that of Prout, when he taught that uric acid is retained in solution by being combined with ammonia. Wetzlar, following up this view, attempts to show that the presence of lactic acid in the urine is not incompatible with the existence of urate of soda in solution; but as soon as the urate of soda meets with a stronger acid, the decomposition takes place, and the insoluble uric acid concretes.

The German chemists have lately shown a tendency to extend the fermentive theory to the formation of all kinds of calculi. Thus Scherer endeavours to connect the deposition of uric acid with a metamorphosis of the urinary pigment. The mucus of the bladder acts as a ferment on the extractive pigment of the urine, a quantity of lactic acid is developed, and

this change is accompanied by the deposition of uric acid. Scherer and Lehmann also attempt to explain the production of an alkaline state of the urine by an alkaline fermentation, which, according to them, is induced, like the acid fermentation, under the influence of altered mucus.

Finally I may allude to the theory of Mr. Queckett, which differs essentially from all those which have been put forward on this subject. Mr. Queckett thinks that we may have two kinds of calculous formations, the one, usually termed a sediment, which may be deposited on any foreign substance existing in the bladder, the other commencing in the secreting cells of the kidney, as takes place naturally in the kidneys of reptiles and birds, or in the higher animals and man as the result of disease.

Mr. Queckett appears to have adopted this theory from observing the manner in which inorganic substances like those composing calculi are formed in the vegetable and animal kingdoms; one and all have an organic basis, and in most cases, if not in all, they are originally developed in cells.

Under the cuticle of the onion may be found cells containing oxalate of lime crystals, exactly similar to those contained in human urine.

The secreting cells in the kidneys of birds and reptiles produce solid uric acid; phosphate of ammonia and magnesia has been found in tubes underneath the mucous membrane of the stomach of the rhinoceros.

On treating with dilute acid the small calculi often found in the urine of the horse, the carbonate of lime

disappears, and the cellular nature of the organic basis is distinctly seen. Finally, on treating in the same way the crystalline portions of a human calculus, the inorganic elements disappear, and an organic basis, similar in shape to the original masses and sometimes exhibiting a cellular structure, remains behind.*

I have alluded only to a few of the illustrations by which Mr. Queckett supports this interesting theory; independently of various objections, it seems to me inconsistent with the rapid manner in which urinary deposits vary, for I cannot admit any essential difference between the nature of deposits and concretions.

The statements hitherto made include nearly all that is of a general character in regard to the etiology of calculi; what remains to be said is of a more particular description.

It is usually stated that calculus is more common in temperate than in warm or cold climates; some further examination, however, of this statement is still required. Humid countries, of moderate temperature, have commonly been supposed to be the chief seat of calculous complaints; Holland, France, England, and Germany, are enumerated as exhibiting the prevalence of calculous disorders in the most striking degree. With regard to the exemption of some, and especially of intertropical countries, very discordant accounts prevail. Dr. Marcet states that he learned from Dr. Scott,

* Lectures on Histology, Med. Times, November 29th, 1851, p. 553.

so well known as particularly conversant with the diseases of India, that there calculus is an unknown disease. Dr. Scott says, "the formation of stone in the urinary bladder is nearly unknown between the tropics. I have indeed not met with a single instance of it, although I have known some cases where such a disease was imparted and not removed by climate." On the contrary, Dr. Brett affirms that calculous complaints are frequent in India; he says that he has known lithotomy practised at Benares many times, and that he himself has operated on several occasions. It is not unlikely that Dr. Scott refers merely to the exemption of Europeans in India; while it is plain that what Dr. Brett speaks of is the frequency of this occurrence among the natives. He ascribes the prevalence of the disease, especially among the native children, to errors in diet, and in particular to the over free use of rancid sweetmeats and coarse unleavened bread. Dr. J. Jackson, in a letter to Mr. Crosse, of Norwich, also states that calculi are frequent throughout India, attributing their prevalence to bad diet, and in particular to the use of unfermented bread,—he also refers to the native population. Staff-surgeon Allen states, that he inquired particularly into this subject while resident in the Mauritius, and that he found uric acid gravel to be very common among young people, and that calculi were very far from being unknown.

The natives of India are certainly not exempt from calculous diseases, though we know nothing relative to the frequency of the complaint in the East. Dr. Morehead, in his work on the diseases of India, informs us that Ram Narain Doss, the teacher of military surgery

in the Bengal Medical College, has performed lithotomy in more than 200 cases.*

Coloured people seem rarely to suffer from calculous complaints. During a residence of ten years in Kentucky, Dr. Gross† does not recollect to have met with a solitary example of gravel or stone in a coloured person. Dr. Dudley, who enjoys one of the largest practices in that part of the world, has never cut more than two or three of these people, who are constantly exposed to hard labour, and fare often upon the coarsest food. The disease is rare in Canada, Texas, Mexico, and California. In the United States, a larger number of children are affected with this disorder in Kentucky, Ohio, Tennessee, and Alabama, than in any other region. The inhabitants of Missouri, Iowa, Wisconsin, Michigan, Indiana, New York, and New Jersey, are comparatively exempt. I have mentioned these facts upon the authority of Dr. Gross, because they confirm that which has been so long observed in this part of the world, namely, that calculous disorders are much more prevalent, from causes hitherto wholly unexplained, in some districts than in others. The county of Norfolk has long had a character of this kind; and many surgeons, among whom I may mention Mr. Martineau, have enjoyed a high reputation for operative skill and success in lithotomy, acquired through the numerous cases which came before them.

To the second edition of his work, recently published,

* Clinical Researches on Diseases in India, vol. ii, p. 303.

† A Practical Treatise on the Diseases and Injuries of the Urinary Bladder, the Prostate Gland, and the Urethra, by S. D. Gross, M.D. Philadelphia, 1851.

Dr. Gross has added an elaborate appendix on the prevalence of stone in the United States; but he has not been able to ascribe the prevalence of the disease in certain parts, and its rarity in others, to any particular cause.

According to the views commonly taken, calculus is much more incident to early years than to any other period; and to old age more than the prime of life. Hippocrates notices the fact, that infants at the breast are not exempt from the disease; and our countryman, Philip Barrough, observes, "Stones in the bladder do engender oftener in children than in older folk."* Some authors have of late denied that children are so subject to calculus as is commonly represented. It is certain that uric acid gravel is very frequent in children under some circumstances, and it is known that calculi have been found in the bladder even at the time of birth. When, however, children are well fed, and proper attention paid to them, distinct calculous concretions appear to be of rare occurrence; yet it is undeniable that the disease is very frequent under the age of puberty in ill-fed children.

I have frequently extracted calculi from children under three years of age. My youngest case was a boy eighteen months of age. The oldest patient on whom I have operated was eighty-six years old, and the case did perfectly well.

I have drawn up the following tables for the purpose of determining, in a more precise manner than has hitherto been done, the relative frequency of calculus at different periods of life. The first table includes only cases which had been submitted to operation.

* Methode of Physick, lib. iii, c. 41, edit. quinta, 1617.

Age.	No. of Cases.	Proportion.
1 to 20	2327	71·20 per cent.
21 40	395	12·10 „
41 60	355	10·87 „
61 80	187	5·72 „
	Total 3264	

From this table it would appear that seventy-one per cent. of persons submitted to lithotomy are under twenty-one years of age.

To ascertain, however, the real proportion of calculous affections at different ages, we must include persons not operated on as well as those submitted to lithotomy, and by this method we obtain a somewhat different result.

Frequency of Calculus at different ages, arranged from M. Civiale's work.

Age.	Cases.	Total.	Proportion.
Up to 5 years	896		
From 6 10 „	1150	2987	55·56 per cent.
„ 11 15 „	555		
„ 16 20 „	388		
„ 21 25 „	242		
„ 26 30 „	218	790	14·69 „
„ 31 35 „	162		
„ 36 40 „	168		
„ 41 45 „	167		
„ 46 50 „	224	804	14·95 „
„ 51 55 „	159		
„ 56 60 „	254		
„ 61 65 „	316		
„ 66 70 „	261	776	14·43 „
„ 71 75 „	138		
„ 76 80 „	61		
„ 81 89 „	17	17	
	5376	5376	

From the above table it would appear that $55\frac{1}{2}$ per cent. of calculous patients are under twenty-one years of age. Dr. Prout estimates the proportion at 62 per cent.

The above tables exhibit the numbers of calculous persons at different ages of life, but they do not show the liability of individuals to be attacked at these different ages. Here, as in so many other statistical tables, an error has crept in from not taking care to distinguish between absolute and relative numbers. To determine liability, the absolute numbers should be corrected by the numbers of persons living at the several periods of life enumerated. Thus, if all persons under twenty were affected with a certain disease, and all persons over seventy were affected with the like complaint, it is evident that the liability would be the same, though the absolute number of persons attacked would be very different.

Corrected in this manner, the tables would show that children and young persons are less liable to calculous disorders than has been commonly supposed; and that from twenty years upwards, the tendency goes on increasing in a very remarkable manner to the end of life. Thus, out of every 100 persons living, the numbers are

Years.	Persons living.
Up to 20 . . .	46
From 20 to 40 . . .	30
„ 40 to 60 . . .	16
60 and upwards . . .	7

On the other hand, the proportion of calculous patients

at these different periods are, according to M. Civiale's table, up to 20 years, 55 per cent.; from 20 to 40, 14 per cent.; 40 to 60, 14 per cent.; 60 and upwards, 14 per cent. or thereabouts. Hence it follows that the liability to attack amongst young persons is below 25 per cent.; while, during the bidecennial periods that follow youth, the liability increases in the relation of 7, 16, and 30. From 40 to 60 persons are twice as liable to stone as those between 20 and 40, while beyond 60 they are four times more liable to the complaint. In fact, the liability will be obtained by dividing the numbers attacked by the numbers living at each period.

If this be done, the liability to stone at different epochs of life will be expressed by the following numbers: In the young (up to 20 years) 65; in adults, (20 to 40) 26; in middle age, (40 to 60) 50; and in the aged (over 60) 111.

All authors who have written on this subject concur in stating that females, notwithstanding their sedentary habits, are much less subject to calculus than males; the reason for this is apparent, besides their more temperate and regular mode of living—namely, the lesser complexity in the form and construction of the urethra in females than in males, its more dilatable nature, and the absence of the prostate gland. When a calculus descends from the kidney into the bladder, or when a calculus by any accident is formed in that viscus, it is most usually expelled during micturition by the mere efforts of the bladder to empty itself, and it is sometimes surprising to what an extent the female urethra spontaneously allows of being distended. Tul-

pius* relates the case of a lady, aged 89, who spontaneously passed a calculus, per urethram, weighing three ounces and two drachms; but it appears to have paralysed the sphincter vesicæ, as she was ever afterwards troubled with incontinence of urine.

In another work† I have shown that out of 2238 patients, 111 were females, making a proportion of 1 female to 20 males. According to Dr. Prout, it is as 1 to 23.

It is a popular belief, that water strongly impregnated with calcareous matter is apt to produce stone; and the prevalence of this disease in Paris countenances the supposition,—a supposition which even the philosophical Hales entertained. But were this a cause, calculous disorders would be far more frequent than they are.

The water of the Seine abounds with carbonate of lime, and were the disease attributable to it, we naturally should expect the nature of the calculi would correspond with the character and quality of the water; but we know this not to be the case, and few calculi are more rare than those composed of the carbonate of lime.

Van Swieten observes, that the Caroline Hot Baths quickly incrust with a strong matter whatever bodies are immersed therein; yet they are extolled by many for their lithontriptic virtues.

The notion that the prevalence of calculous complaints in particular districts depended on the character of the

* L. iii, obs. 7.

† Lithotrity and Lithotomy, p. 247.

water used by the population for drink, arose at a time when the etiology of such diseases had made no progress whatever. It is plain that none of the forms of calculi correspond with the salts which exist in natural waters; and the only mode in which the salts contained in these could operate to the production of calculi, would be by causing a deposit of the salts which naturally exist in the urine. Hence, as being of a somewhat alkaline character, calcareous waters might be supposed to favour the deposit of phosphates from the urine. This, however, has not been observed, and the quantity of calcareous matter in such waters is probably too small to have any such effect. On the contrary, various calcareous waters, as those of Buxton, Malvern, Matlock, have had a reputation for counteracting the calculous tendency. These waters, however, act merely as diluents, washing out the saline matter from the system, and are all remarkable for their extreme purity, notwithstanding they contain a minute proportion of calcareous matter.

We have the authority of Van Swieten for the fact, that calculous disorders are common in Holland; and the circumstance is the more curious, considering that gin, a powerful diuretic, is the spirit most in use in that country. Nevertheless, among the Dutch who come from Europe, and inhabit Batavia (Java), stone is a rare disease, although their manner of living does not differ from that pursued at home. Denys, who resided in that island for some years, tells us that he could find only two persons who were obliged to submit to the operation of lithotomy. He further observes, that the water they drink, flowing

from the neighbouring mountains, is much impregnated with earthy matters.

Calculous diseases are well known to prevail in Norfolk more than in any other county in England; the cause of this greater prevalence is not, however, ascertained; whereas, according to Soemmering, these affections are unknown in some situations bordering on the Rhine. Liebig is of opinion that the exemption of the inhabitants of the countries bordering on the Rhine from calculus and gout, arises from the character of the Rhine wines, as containing a large quantity of tartar. The use of many kinds of wine unquestionably is favorable to the development of the uric acid diathesis; but, according to Liebig, the bi-tartrate of potash, which is abundant in the Rhine wines, being changed to the carbonate of potash in the progress of digestion, acts the part of an alkali, and secures the inhabitants against the deposition of uric acid.

It had long been believed by medical authorities of the highest estimation, even before the chemistry of calculous concretions was understood, that acids were among the most active causes of gravel; and since chemistry has afforded a still more exact and intimate knowledge of all the sources of this complaint, pathologists have been able to trace a new and more hidden cause of urinary concretions in acidity generated in the alimentary canal from a morbid condition of the digestion.* It is to this latter source that the separa-

* "Wherever," says that accurate pathologist, Murray Forbes, "fermented liquors are a common beverage, stone and gravel have been observed to be more than usually frequent."

tion of uric acid has been traced; and all know how large a share this has in the composition of stones in the bladder. It is true that this view has often of late been controverted by chemical authorities; but among practical writers there is hardly any opinion in regard to urinary calculi on which there is so complete an agreement. To this cause, namely to the use of acescent wines in France, and of malt liquor in Britain, the prevalence of calculi has often been ascribed; and it is even alleged, on something like authority, that calculous complaints have been much less frequent in England since the time when hops began to be largely added to beer. Among recent authors, Magendie is one of the strongest supporters of the effect of acid in the production of urinary concretions, insisting, at the same time, as before remarked, on the effect, or the concurrent effect of a rich animal diet. Mr. Crosse, of Norwich, is also among the recent writers who considered the prevailing source of urinary calculi to be dyspepsia, leading to the generation of acid in the stomach, and to the superabundance of uric acid in the urine. He, however, is against ascribing the origin of urinary concretions to any one cause, expressing his opinion that neither the food, the soil, nor the beverage, used by the inhabitants of Norfolk, has great effect in producing the tendency to calculous complaints in that county; and he is inclined to ascribe some part at least of this tendency to the variableness of the climate of Norfolk, and to the prevalence, as he says, of north-east winds. Mr. Crosse illustrates this, by stating that he has known persons quite free from any calculous tendency come from London to Norfolk to reside for a few

weeks, and during that period contract a disposition to the disease.

Dr. Wilson Philip has thrown the result of his observations on the origin of calculous complaints into a few distinct propositions, which deserve to be quoted, though in some respects they are at variance with the views which have been more recently taught on this subject.

1. That rancid and acescent ingesta tend to increase the deposition of uric acid from the urine, and to prevent that of the phosphates.

2. That a diet composed of a large proportion of animal food tends to lessen the deposition of uric acid, and to increase that of the phosphates.

3. That everything which promotes the action of the skin tends to prevent the deposition of uric acid, and to occasion that of the phosphates.

4. That dyspepsia tends to increase the deposition of uric acid, and to lessen that of the phosphates, both by producing acidity of the primæ viæ, and by rendering the skin inactive.

5. That indolence has the same tendency both by inducing dyspepsia, and by lessening the activity of the skin, in proportion as it impairs the vigour of the circulation.

6. That an acid passes by insensible as well as sensible perspiration.

Respecting the first of these propositions, as has been already remarked, most practical writers are fully agreed. As to the second, it has been seen that Magendie holds a totally opposite view. He says, that when animals live altogether on flesh, their urine is full of uric acid, and even may be entirely composed of it, as is proved

with respect to birds, by the experiments both of Dr. Wollaston and Vauquelin. On the contrary, if animals live on vegetables, as is the case with the herbivorous class, there is no appearance of uric acid in their urine. In a series of experiments communicated by Magendie to the Academy of Sciences, in 1816, it is reported that if a carnivorous animal be deprived of all nutriment containing nitrogen, and be fed with sugar, gum, oil, and other substances considered to be nutritious, though they have no nitrogen in their composition, the urine in three or four weeks will contain no uric acid. The inference which Magendie draws from his experiments, and from some cases which he has detailed, is, that the quantity of uric acid in the urine, and of course the tendency to gravel and calculous disorders, depends very much on the kind of food. However, he takes into consideration the relative proportion of the uric acid to the urine itself, because if this be also abundant, the liability to calculi is counteracted. It would appear also, from his observations, that the urine is not only impregnated with a large proportion of uric acid in animals which eat a large quantity of flesh, but is also scanty; and that, on the other hand, a vegetable diet always promotes the secretion of a large quantity of fluid from the kidneys, as well as checks the formation of the acid in question. Magendie is also disposed to believe that the rarity of calculi in hot climates may be partly traced to the kind of food employed. In fact, it is well known that in a considerable part of Asia, many millions of the inhabitants never eat flesh. Thus, these views may be allowed to have full weight, with respect to the sects which religiously decline animal food; but the influence of

climate cannot be rejected, because calculi are rare in al hot countries, whether meat be freely eaten or not. At the same time, the general tenor of this reasoning may be true, that the influence of climate and vegetable diet tends to prevent the formation of uric acid calculi, while large quantities of such food as contains a great deal of nitrogen has the opposite effect.

With respect to the third proposition, there is good reason to think that it is essentially correct. It has long been remarked, that when the action of the skin is defective, there is a tendency to the deposition of red sand in the urine. And it has commonly been supposed either that uric acid is secreted by the skin when the perspiration is copious, or else that some other chemical compounds are thrown forth by that change, the formation of which renders the excretion of uric acid from the living system unnecessary. It is a matter of common observation that when perspiration becomes unduly great it acquires an urinous smell. It is also well known that when perspiration is kept up to great excess for a number of hours, the deposit in urine consists of phosphates. For example, after such exercise as dancing for many hours, there is often a white deposit in the urine. This kind of deposit, under such circumstances, is exactly what we should expect in accordance with Liebig's views.

Violent exertion of the muscular system, such as long-continued dancing, must cause an unusual disintegration of the muscular tissues; but since this disintegration is connected with great activity of the respiration, and therefore with a full supply of oxygen, the product will be rather an abundance of urea than of uric

acid. In short, it may readily be conceived, on Liebig's principles, that the proportion of uric acid to the urea, in such a case, is much less than under ordinary exercise. At the same time, a large disintegration of the muscular tissues cannot take place without a considerable proportion of phosphates being set free, and mingled with venous blood, from which, after it has passed through the lungs, they are finally separated by the kidney. What Magendie says on this subject is, that excessive perspiration, by diminishing the amount of fluid in the urinary secretion, produces a relative superabundance of uric acid, so as to become a cause of the uric acid concretion. It seems possible that when excessive perspiration is unaccompanied with muscular exertion, and increased activity of the respiration, what Magendie says may be correct, thus affording a limitation to the proposition just cited from Wilson Philip's paper. With respect to the fourth proposition, no further remark need be made upon it, after what has been said above, neither do the two subsequent propositions require any further observation.

Under the head of the causes of urinary concretions, it would be improper to omit some notice of the remarkable view taken on this subject by Mr. Copland Hutchinson. The object of Mr. Hutchinson's paper is to show, that sailors and seafaring people enjoy an extraordinary degree of exemption from calculous complaints. He estimated the number of seamen received as patients into the great naval hospitals during sixteen years; and out of 86,000 patients he found that there had been no more than eight cases of calculus. He also made particular inquiries at the great hospitals of

England, and found that the exemption from calculus was as great in the mercantile navy as in ships of war. Mr. Hutchinson has certainly succeeded in showing that calculus is not a disease to which seamen are particularly subject. Doubts, however, have been entertained as to whether the data on which he proceeds are sufficient to show that they possess a special exemption from this complaint. Sir George Ballingall has made it appear that soldiers enjoy a similar exemption. On this point Mr. Samuel Cooper remarks: "Mr. R. Smith, of Bristol, has published an interesting statistical inquiry into the frequency of stone in the bladder in Great Britain and Ireland, though strictly it is a comparative estimate of the number of operations for stone in different parts of the kingdom in given spaces of time, and in all the number of calculous patients. So far as I can judge from the facts stated in Mr. Smith's paper, and from what I know about the average number of operations for stone in London, not more than 180 can be fairly reckoned as the annual total of Great Britain and Ireland, which is about one for each 100,000 of the population taken at 18,000,000." Now, if this fact be recollected, in reasoning about the rarity of stone operations in the navy, and the other circumstances, of their being few children and old men in that service, and of every man being examined by a surgeon as to the state of his health before he is entered, I think the reason of the unfrequency of the stone in the navy will be tolerably clear. However, as sailors live partly in hot, and partly in very cold climates, even if they were of the ages most subject to calculi, they may perhaps be

rather less disposed to the complaint than those individuals of the same periods of life constantly resident in England. In Sweden, urinary calculi are said to be unfrequent; and as surgery is there highly cultivated, the statement weighs considerably in favour of the truth of the general belief of the rarity of this disorder in very cold countries; but, as I have already said, the number of inhabitants to which any particular evidence on this point relates, is an essential inquiry, before a safe inference can be drawn. Notwithstanding these objections, Mr. Hutchinson's paper must be regarded as a valuable contribution to the medical history of calculous complaints; for though seamen may not be more exempt than some other classes of the community from this disorder, it is at least satisfactory to know that so large a body of men, living in a special manner, and on a special kind of diet, should enjoy an almost complete exemption from this malady; the more so, because the ordinary diet of seamen cannot be regarded as particularly favorable to the healthy exercise of the organs of assimilation. The most striking peculiarities of a seafaring life, in the British navy, particularly at the time when Copland Hutchinson wrote, are, first, that the men live very largely on animal diet, with bread, but without fresh vegetables; that they have few opportunities of drinking wine or malt liquor; that diluted spirits constitute their daily drink; that they pass their lives freely exposed to the atmosphere, and therefore exercise the functions of respiration with an unusual vigour; and, above all, that they seldom retain the urine in the bladder after the first call.

I have already alluded to the fact that the presence of a foreign body in the bladder may be a determining cause of stone.

Cheselden, in his 'Anatomy of the Human Body,' notes two extraordinary calculi found in the bladder; one was cut out from the bladder of a soldier, in St, Thomas' Hospital, the nucleus of which consisted of a bullet that had been discharged from a musket, and lodged in the bladder; the other was extracted from a boy five years of age, in the centre of which was discovered a needle. The celebrated Nuck* demonstrated the above fact by an experiment: Having opened the abdomen of a live dog, he drew the bladder out of the wound, and made an incision in the fundus with a sharp knife; through this wound he introduced a little round wooden button, and as soon as the fibres were in a state of contraction, he replaced the bladder in its natural situation, and sewed up the wound. The animal for the first two days seemed dull and sick, but in a little time the natural appetite and alacrity returned, and the only uneasiness observed was a more frequent inclination to make water than usual. Some weeks after, he dissected the dog in his private theatre, and the button being extracted, appeared covered with a calculous crust. Many physicians, Hippocrates tells us, believed that when they thus saw sand in the urine, there was a stone in the bladder; but this he contradicts. Neither can we always depend on the character of the sediment as affording a certain indication of the constitution of the stone.

* Adenograph. Curios., p. 80.

Dr. Wells* gives the case of a man in whom sounding detected the presence of a calculus, and his urine deposited a "white powdery sediment." "This," he adds, "I examined, and found to consist of the urate of ammonia." The patient eventually died, when analysis showed "that the whole of the calculus, except the nucleus, was composed of triple phosphate of magnesia and ammonia. The nucleus, which was very small, consisted of uric acid."

It may be supposed that the concretions which occur elsewhere in the living system, might throw some light on the generation of urinary calculi. Such concretions not unfrequently assume the same rounded form with urinary calculi, but there is little agreement with them in their composition. The tophi, or chalk stones, which form on the joints of gouty persons, are the only concretions elsewhere in the body which distinctly participate in the same kind of character as urinary calculi. These concretions contain uric acid, and consist in general of urate of soda.

The concretions assuming the form of urinary calculi in other parts of the body are calcareous, and for the most part consist of phosphate of lime. Such calcareous deposits have been found in the heart and blood-vessels. They appear to be composed of phosphate and carbonate of lime, with some animal matter, and are probably depositions from the blood.

Man is not the only animal subject to urinary calculi; in the higher mammalia we often notice that their

* Transactions of a Society for the Improvement of Med. and Chir. Knowledge, vol. iii, p. 192.

formation, passage into the bladder, and gradual increase in size, are attended by the same train of symptoms as those with which we are familiar in our own species. The Museum of the Royal College of Surgeons contains specimens from the monkey, dog, rat, rabbit, hog, horse, ass, ox, sheep, elephant, whale, eagle, ostrich, fowl, tortoise, iguana, and sturgeon. Several of these specimens, however, are unauthenticated, and others are ascribed to animals in which it is scarcely possible they could have occurred. The collection shows that graminivorous are more liable to calculous disorders than carnivorous animals; also that calculi from the lower vertebrata consist in greater part of carbonate of lime. In the private collection of Dr. Gross, of Louisville, U. S., there is a beautiful specimen from the bladder of the hog; it is of a whitish colour, of a rounded, oblong shape, very rough on the surface, and weighs eight ounces. Professor Cobb has a magnificent calculus taken from the bladder of a dog. "Rats and mice," observes Dr. Gross, "are said to be particularly subject to urinary calculi, and the disease is also met with in the cat and the rabbit." In the former animal I have met with two instances of this affection; in neither, however, was the presence of a calculus suspected, the animals being both destroyed in consequence of their becoming mischievous, irritable, and emaciated. Professor Silliman has a calculus taken from a whale. It follows, therefore, that living in a perfectly natural state, and partaking of the simplest kind of food, do not render the animal frame exempt from calculous affections.

Stone in the bladder may exist at all periods of life.

It has been described in some rare instances as an intra-uterine affection. Professor Langenbeck, of Berlin, informed me that he once met with a small uric acid calculus in the bladder of a six month male fœtus. Geyer* has recorded the case of a boy who suffered from calculus from birth; he was cut in his twelfth year, when the stone had acquired so large a bulk, that it had to be broken before it could be extracted. The whole mass weighed ten ounces. Stahl found a calculus the size of a peach-kernel in an infant of three weeks, who had from its birth suffered great distress in passing water. I have, upon many occasions, extracted calculi from children under three years of age. My youngest case was a boy of eighteen months. The oldest patient upon whom I have operated was eighty-six years old, a patient of Mr. Wilkinson's, of Sydenham.

* Miscel. Nat. Curios., Dec. II., An. V, p. 450.

CHAPTER XVIII.

SYMPTOMS OF STONE IN THE BLADDER.

With the exception of some rare instances, in which the nucleus consists of a foreign body, urinary calculi are first formed in the kidney; while small they descend along the ureter into the bladder, where they increase by a succession of layers deposited from the urine. If smooth and small, the passage of the calculus down the ureter excites little or no inconvenience; it may remain even in the bladder a long time without the patient being aware of its presence. If, however, the renal calculus be rough, and of some size, its descent into the bladder is attended with most excruciating suffering—the pain extending from the back down the thighs, and along the course of the chord, being sufficient to "double the patient up," and make him roll in agony on the ground. The descent generally occupies from twelve to twenty-four hours. The usual symptoms in the milder cases are, nausea, rigors, restlessness, and some alarm; pain in the back, coming on more severely in paroxysms, and extending down the thighs; retraction of the testicles, coldness of the extremities, and extreme prostration.

The calculus may become impacted in the vesical orifice of the ureter; the flow of urine from the corresponding kidney will then be prevented; dilatation of the ureter and distension of the tubular structure of the kidney will ensue, terminating in absorption of its secreting surface; but most of the usual symptoms of stone in the bladder will be absent.

When a calculus is loose in the vesical cavity it falls to the most depending part behind the prostate; but it shifts about according to the posture of the patient, and gives rise to symptoms which are more or less marked in different cases.

In the earlier stages of stone in the bladder, while the organ is healthy, the patient experiences a dull sense of weight about the neck of the bladder, with pain or uneasiness extending to the hypogastric region, perinæum, groin, or thighs. The bladder becomes irritable and cannot retain its contents; the calls to make water are frequent, and the expulsion of the last drops is attended with pain, which shoots along the perinæum and penis, and centres in the glans. Sometimes when the urine is flowing in a full stream, it is suddenly stopped, evidently in consequence of the foreign body falling across the orifice of the urethra, and mechanically obstructing it. The patient finds he cannot take any violent exercise without suffering pain; the jolting of a carriage increases his symptoms, and is frequently followed by a discharge of bloody urine, while in some constitutions, hæmorrhage to a considerable extent takes place. As the stone increases in size, micturition becomes more frequent and distressing, and especially the pain or uneasiness at the

end of the penis. The last drops of urine are expelled with a spasmodic effort of the bladder, which endures for some time, and the contents of the bladder and vesiculæ seminales are often involuntarily passed, adding materially to the distress and exhaustion of the patient. There is occasionally priapism, with or without sexual desire.

These symptoms come on slowly; indeed, if the stone be smooth, and the bladder healthy, there may be nothing for a considerable time to direct the patient's attention to his case. Sooner or later, however, indications of disturbance of the urinary organs ensue, and the features of the affection become well marked.

The pain and sensation of weight about the neck of the bladder are two of the earliest symptoms. The pain varies in character, being sharp and acute, as well as dull and heavy. It is described by some authors as sometimes periodical; and Deschamps relates the case of a man, in whom for upwards of eight months pain of a sharp cutting character, produced by stone in the bladder, came on at every return of the new moon. Although, as a general rule, the larger and rougher the stone the more acute the pain, exceptions to this are occasionally met with. I removed from a thin man, of advanced age, an oval stone, which had never excited severe suffering; and there had been great difficulty experienced in detecting its presence by the sound. I presume that in all these cases there is no congested or inflammatory condition of the bladder. When such a state ensues, the sufferings of the patient become greatly aggravated, and, except by operation, there are no means

which we possess of affording effectual relief. Dr. Gross thinks that a spiculated stone, or one studded with long spines, produces often slight suffering, because the spines admit of the more ready passage of the urine, in the same manner that a rough body lodged in the bronchial tube will occasionally cause less distress than a smooth body, as it produces less obstruction to the entrance of the air.

We generally find that in cases of phosphatic calculi there is more suffering than when the stone is composed of lithic or oxalic acid, because in the former there is generally a morbid condition of the kidney, and of the urinary passages. If the patient be of a nervous and excitable temperament, or if he be of gouty or rheumatic habit, the pain experienced is often of an anomalous character, and is described by the patient in excited and exaggerated terms. The patient suffers the least, when, from some cause, the stone has become fixed; thus, an impacted or encysted calculus may remain for years without giving any indication of its presence. If the prostate be enlarged, the bladder partially paralysed, and the power of emptying the organ in a considerable measure lost, the sufferings of the patient are far less intense than in a younger subject in whom no such changes have yet taken place. I have generally noticed that the feeling of weight about the neck of the bladder rarely passes away, and is more complained of after violent exercise than when the patient has remained quiet in the recumbent posture. The frequent calls to micturate are a source of great annoyance to the patient. Sometimes they occur every hour, or even every half hour. Should the calculus have caused ulcera-

tion of the mucous membrane of the bladder, the desire to make water becomes proportionably more severe, so as to be almost, if not wholly uncontrollable.

A moveable stone, falling across the orifice of the urethra, suddenly arrests the flow of urine, a symptom which may be regarded as decisive of the nature of the case, since it is scarcely ever produced by any other cause, excepting, perhaps, pedunculated tumours about the neck of the bladder. The arrest in the flow of the urine does not last more than a few moments; it disappears upon some change of posture, or of its own accord. If the calculus be so small, or of such a shape as to admit of becoming impacted in the urethra, the catheter is required to push it back, or even some operation may be required, from the fact of the stone producing complete retention. Patients have been known during micturition to lie on the back, and to elevate the pelvis; the object being to allow the calculus to drop by its own weight from the urethral orifice.

Children who labour under stone, cry, and even scream, at the time of passing their urine, and especially afterwards; they constantly apply their hand to the end of the penis, and elongate the prepuce in their attempt to deaden the painful sensations which they experience.

It is a common remark, that in such cases the hand is frequently kept on the penis; and children have been corrected for a habit which, to the eye of the surgeon, clearly announced the existence of this serious affection. In adults, erections of the penis and involuntary emissions of semen add to the existing discomfort. The jolting of a carriage,as I have mentioned, commonly produces bloody urine; and a patient obliged to ride much on horseback

would notice the existence of hæmaturia at an early stage of the complaint. This discoloration of the urine may last several days; but it generally disappears with rest and the recumbent posture. When there is ulceration of the bladder the case becomes complicated, and the hæmorrhage is more profuse; but I do not believe that in these cases the blood flows, as a rule, from any other part than the mucous lining of the bladder.

Severe exercise and indiscretions of diet often produce a discharge of mucus, and the quantity is greatest in aged subjects, in whom the bladder has become thickened and diseased. The colour of the mucus is greyish, or greyish-yellow; it is stringy or ropy; more or less fetid, and forms a dense, tough, yellow layer at the bottom of the vessel in which the urine is voided. If it be raised with a bit of wood, it adheres, and drops slowly down in a continuous stream.

Prolapsus of the rectum, especially in young children and old men, is by no means an uncommon complication. It varies considerably in degree; but is at all times a source of great inconvenience, because so frequently attended with the discharge of flatus or fæces.

When a vesical calculus has existed for years, and has brought on severe symptoms, more especially if complicated with stricture of the urethra or enlarged prostate, the kidneys, though before healthy, become involved; the pelvic cavities become altered in shape and enlarged; the infundibula are extended or unfolded; and the lining membrane of the cavities becomes thickened from repeated attacks of inflammation. The parenchymatous substance of the kidney is next more or less absorbed; the mammary projections are obliterated;

cysts, formed of dilated uriniferous tubules, occupy the cortical part; and all the most serious evils that belong to renal affections—ulceration, contiguous abscess, or gangrene—follow in the train, and carry off the sufferer.

There is a look of great distress in a patient suffering constitutionally from the presence of a stone in the bladder combined with disease of the kidneys. He is anxious; the brows are partially contracted and expressive of suffering, both bodily and mentally. He becomes thin and wan; the skin is dry; the extremities are cold; the pulse small; the stomach does not readily receive food; the secretions are vitiated, and the bowels become irregular and irritable. Pains may manifest themselves in parts of the body quite removed from the seat of disease, such as the knee, heel, foot, or arm. Then come on night-sweats and colliquative diarrhœa, and the sufferer sinks from exhaustion. Many circumstances may cause temporary remission of the symptoms, and there is always the possibility of the stone becoming encysted. Cases, too, are recorded, and quoted in another part of this work, where calculi have existed for years in the bladder without giving rise to any symptoms, and have been discovered for the first time upon examination after death. In the majority of cases, however, irritability of the bladder and pain after passing the urine are the only symptoms, especially in the early stage, which distress the patient.

Persons affected with stone, and at the same time subject to gout, (which is by no means an unfrequent coincidence,) require the greatest care as regards an operation proposed for their relief; for any increase of

irritation may bring on an attack of gout, in which the bladder sometimes participates. It is in such cases as these that operations must be promptly performed; for useless and long-continued manipulations are apt to be followed by serious results.

Patients with diseased and enlarged prostate are said not to suffer more than others from stone in the bladder, probably in consequence of the tumour of the prostate preventing the stone falling down on the neck of the bladder. We are indebted to Sir B. Brodie for this practical remark.

A variety of affections involving the neck of the bladder may cause pain and uneasiness in the hypogastric region and thighs; and the flow of urine may be suddenly arrested by a pedunculated tumour falling across the urethral aperture. Blood may be mixed with urine from the vessels of a malignant growth, or from the mucous membrane of the bladder or urethra in many other complaints than stone. When the bladder is inflamed, it is intolerant of urine, and pain is experienced after the expulsion of the last drops. It must, therefore, be laid down as a rule, that we cannot positively pronounce upon the presence of a calculus in the bladder unless it be ascertained by the sound; and there are few operations which differ more in the suffering which they cause to the patient by the manner in which they are performed, than this apparently simple proceeding.

Sounding.—The solid steel instrument called a sound is smaller than a full-sized catheter, resembling it in shape, but with a shorter curve, so that it may be more freely moved within the vesical cavity. It should be

well polished, about twelve inches long, with a broad flat handle; a proportionately smaller instrument being required for children. The curve should form an angle of 45° with the straight portion, and not exceed three inches; the extremity should be smooth and well rounded, that it may not injure the mucous membrane of the bladder, or catch in any of the urethral follicles. But the surgeon should possess sounds of different curves; for general use, that is to be preferred which possesses a short curve, and admits of free movement in the bladder. No one in the present day would think of using the ordinary silver catheter for the purposes of sounding. The instrument is wholly unfit to convey the proper sensation or sound.

Previous to sounding, the bowels should be opened by an enema. If the rectum be distended, it occupies too much of the pelvic cavity, and prevents a satisfactory examination being made per anum, should the case require it.

Care should be taken that the bladder be not empty: the organ would then contract upon the sound, or, in any circumstance, impede its movements so much that the stone might escape the point of the instrument. Warm water can always be injected into the bladder, if it be necessary, and about four or five ounces will amply suffice for the purpose.

The patient having been placed in the semi-recumbent position, the instrument, previously well oiled, should be passed carefully and gently along the urethra into the bladder, the cavity of which is then to be explored. First, the handle should be slightly raised, and the con-

vexity of the sound passed in a sweeping direction from before backwards, along the inferior surface of the bladder from the neck to the fundus. Next, the bladder should be explored laterally by revolving the handle from side to side between the fingers and thumb. Lastly, the instrument is to be withdrawn to the neck of the bladder, and the point is to be directed first downwards to the space behind the prostate, and secondly upwards to the surface behind the pubes. If the bladder be suddenly emptied during the operation, we may withdraw the sound, and slowly inject through a catheter a moderate quantity of warm water by means of a properly adapted syringe. The patient should be supported on a table or sofa so as to enable us to depress the shoulders and bring the fundus of the bladder to a depending position, into which the stone may gravitate. Sounding a patient is an operation which cannot be satisfactorily performed in a hurry; and it may be necessary to repeat the proceeding several times before we can form a positive opinion on the presence of stone or not. It may excite in some patients such severe suffering that it becomes advisable to exhibit chloroform, which, by producing insensibility, greatly facilitates the examination.

A hard stone, as the oxalate of lime or the lithic acid culculus, rings when struck, and communicates through the instrument a peculiar sensation. A soft calculus, composed of the phosphates, conveys a more equivocal feeling to the surgeon; the instrument strikes against a hard unyielding substance, but the sound is less sharp, sometimes almost inaudible. The size may be partly guessed

by marking the extent of hard surface over which the sound passes, and the readiness with which the calculus is found in all conditions of the bladder. But considerable experience is requisite to form an accurate notion of the size of a stone, unless we introduce the instrument used in lithotrity, in which the amount of separation of the blades is indicated by a graduated scale on the handle. The stone may thus, if requisite, be measured in every direction. The larger and harder the stone, the more audible in general the sound communicated by the instrument. It is quite different from the grating sensation indicative of a fasciculated condition of the bladder, and may often be heard at the distance of several yards. The introduction of the finger into the rectum for the purpose of lifting the surface of the bladder behind the prostate, though very often practised, is requisite chiefly in old persons.

Sounding is an operation not wholly free from danger. It may produce acute inflammation of the bladder, than which no more formidable affection exists. Mr. Fletcher* relates the following case :—A healthy boy, six years old, was brought to the hospital with symptoms of stone, for which he was twice sounded by the surgeon, who satisfied himself, on both occasions, of the existence of the complaint. On the day, however, appointed for the operation, he could not detect it, and several of his friends tried successively with no better success. The surgeon at length put a stop to these proceedings; but his interference was too late. The boy was put to bed, complaining that his belly ached.

* Medico-Chirurgical Notes and Illustrations.

Active peritoneal inflammation followed; and, notwithstanding the most energetic means to control it, death took place on the fourth day after sounding. The inner membrane of the bladder was spotted deep red everywhere, and its peritoneal coat was glued to that of the intestines, which were on all sides inflamed and covered with lymph. Dr. Prout informed me that a patient of his in fair health died forty-eight hours after being sounded by one of the best surgeons of the day.

Dr. Gross sounded a young man, in 1844, who had suffered for twenty-four years from stone in the bladder, attended with chronic cystitis, and great disorder of the general health. The operation was performed with all possible gentleness, and yet three weeks elapsed before he was sufficiently recovered to justify the performance of lithotomy. Severe cystitis ensued, accompanied with violent spasm of the bladder, and the bowels became tympanitic and exceedingly tender on pressure, evincing the existence of peritonitis. These symptoms gradually yielded to the ordinary antiphlogistic remedies, but not without inducing the belief at one period that the patient would die. Sanson, Civiale, Crosse, and others, have recorded similar, and even fatal cases. "In consequence," says Mr. Crosse, "of persevering and unsuccessful attempts to discover a stone with the sound, in a little boy, inflammation of the bladder came on, attended by vomiting, and extending to the peritoneum; the most antiphlogistic treatment failed to arrest it, and death ensued in four days."

The practice of auscultation, by applying a stethoscope to the pubic region, the sacrum, or the perinæum, as recommended by Laennec, is not adopted by modern

surgeons, for the unassisted ear can detect, if possessed of its proper power, the contact of the steel instrument with the stone. It has been recommended by Dr. Ashmead, of Philadelphia, to distend the bladder, in doubtful cases, with air introduced by a proper syringe, after the withdrawal of the urine, the former being a better conductor of sound than the latter. The proposal, ingenious as it is, has not met with encouragement.

Before the operation of lithotomy be commenced the presence of the stone should be established upon the most unequivocal evidence, and that can be only obtained by the process of sounding, as commonly performed.

In a former publication, I alluded to the difficulty which surgeons often experience in determining on the presence of stone in the bladder. Numerous instances are on record of large stones being found after death, the existence of which could never be verified during life by the most careful examination. As an instance of a stone being present, and yet not detected by the sound, I may mention the following case, quoted from Dr. Gross's work on 'Diseases of the Urinary Organs' :—"Mr. Harding, an elderly gentleman, of Philadelphia, and a captain in the merchants' service, had laboured for several years under all the usual symptoms of stone in the bladder. As he made frequent voyages to Liverpool, he determined, on one of these occasions, to visit London, for the purpose of submitting his case to Mr. (now Sir Benjamin) Brodie. A most thorough exploration of the bladder was made by this gentleman, so distinguished for his knowledge

of urinary diseases; but no stone was found. Upon his return to America, Captain Harding lost no time in consulting the late Dr. Physick, who lived within one hundred miles of his own residence. A calculus, of considerable size, was promptly detected by the sound, and in a few days removed by the lateral operation." These facts, observes Dr. Gross, were communicated to me, upwards of twenty years ago, by Captain Harding himself, who was a very respectable and intelligent man.

Some time ago, I saw a gentleman who had been sounded by an experienced surgeon, who was unable to say whether there was a stone in the bladder; the examination caused a good deal of pain, and was never repeated. Sixteen months after, the patient died, and a stone was found in the bladder weighing four ounces and a half, too large, as we may fairly suppose, to have formed since the sounding; the bladder was rather small, and the prostate not enlarged. I have been informed that the largest calculus in the museum of St. Bartholomew's Hospital was taken from a patient who was often sounded, but in whom the presence of stone could never, during life, be ascertained, although there was little or no doubt in the mind of the surgeon of its existence. In the museum of the Royal College of Surgeons, there is a bladder taken from the body of a man, who committed suicide after long and unalleviated suffering from stone, the presence of which had never been detected, though he was repeatedly sounded by the late Mr. Abernethy and others. The bladder contains a large, rough calculus, of an oval form, which measures in its several diameters

about $1\frac{3}{4}$, $1\frac{1}{2}$, and 1 inch. The mucous membrane is thickened, indurated, and superficially ulcerated. The muscular and cellular coats also are thickened, and the peritoneum and other tissues round the bladder appear condensed and unnaturally adherent. The ureters are dilated and thickened; both the bladder and prostate are of ordinary size.

Repeated examinations of the bladder with the catheter, observes M. Civiale,* have failed, even in the hands of the most experienced surgeons, such as Cheselden, Pelletan, and Dupuytren, to determine the existence of stone. Verzascha,† Benevoli,‡ Duretus,§ Riverius,‖ Marcellus Donatus,¶ Chesneau,** Valentin,†† Riolanus,‡‡ Morgagni,§§ Covillard,‖‖ Tolet,¶¶ Colot,*** Morand,††† Deschamps,‡‡‡ and Chopart,§§§ state facts

* Traité de l'Affection Calculeuse, p. 477. Paris, 1838.

† Obs. 52, p. 109.

‡ Masotti, Lettera sopra gl'instrumenti, &c., p. 31.

§ Schol. in J. Holler. de Morb. Int., lib. i, c. 46, p. 143. Two calculi, each weighing two ounces, were found after death.

‖ Praxis Med., i, 14, c. ii, p. 179.

¶ De Medic. Hist. Mirab., 1, 4, c. xxx, p. 453. A large stone was discovered after death.

** Obs. 1, 3, c. x; Obs. 2, p. 354. A calculus as large as a goose-egg was found after death.

†† Chirurg. Med. Sec., iii, c. 7, sect. ix, p. 352.

‡‡ Anthrop. 1, 2, c. xxviii, p. 150. Riolanus quotes the case of Casaubon in reference to this.

§§ De Sedibus, Ep. 42, art. 10.

‖‖ Obs. Iatro. chirurg., p. 42.

¶¶ Traité de la Lithotomie, p. 77.

*** Traité de l'Op. de la Taille, p. 167, 170, et 172.

††† Traité de la Taille, p. 276.

‡‡‡ Ibid., t. i, p. 254.

§§§ Traité des Maladies des Voies Urin., t. i, p. 55.

which prove that large calculi, of the size even of a hen's or duck's egg, nearly filling the bladder, have escaped the most minute and careful examination. Even where there are numerous calculi, they cannot always be detected. Colot says he sounded a man of sixty, and though unable to ascertain the existence of stone, operated on him, and extracted twenty-two calculi, which were hard, and of the size of a hazel-nut. Lapeyronie died of stone; his bladder contained a calculus weighing more than three ounces, which was not discovered during life, although he had been sounded several times. Portal and Distel also died of this affection, but in neither could the stone be detected with the sound until it was too late to operate. M. Kruger Hansen* relates the case of a man who suffered for a long time from dysury, and in whom a stone could never be felt. After death a very large calculus, covered with small pointed elevations, was found in the bladder. M. Leroy† also mentions similar instances.

Cases not unfrequently occur in which a stone is felt distinctly at one time, and not on another, although the examination is made by the same surgeon, and, as nearly as possible, under the same circumstances. Mr. Crosse, in his work (fig. 9, plate i.), "refers to two calculi found after death in a gentleman who was about to submit to lithotomy; but the stone, previously ascertained to be in the bladder, could not then be felt."

A boy, aged twelve years, was admitted into one of

* Beitræge Mecklenb. Aerzte, t. i, p. 115 et 123.

† De la Lithotripsie, p. 56.

the metropolitan hospitals with symptoms of stone; on the first examination, a stone was felt, but when the boy was put on the table to be operated upon, the stone could not be detected. He was brought a second time for the same purpose, but no stone could be felt. The parents shortly after removed him from the hospital. Not long after, the boy was brought to the General Dispensary, and the circumstances of the case related by the parent. It was determined to prepare the boy for the operation for stone, and then sound him, so that in the event of a calculus being discovered the operation might at once be performed. On introducing a sound, the calculus was dintinctly felt, and I removed a calculus, weighing a little more than a drachm. Two cases occurred to me in which considerable difficulty was felt by myself and others in detecting a stone in the bladder. One, a child three years old, had been taken to an hospital and examined three times, but no stone was detected. I saw the child afterwards and sounded it three times, allowing an interval of a month between each examination, and it was only on the third occasion that I detected the calculus. Just before operating, considerable difficulty was again experienced in feeling the stone; and it was not until the finger was introduced into the rectum, and the neck of the bladder raised, that the stone could be felt. The operation was then performed, and a stone composed of lithate of ammonia, and weighing one drachm and six grains, was removed. It was situated in a pouch at the neck of the bladder, so that the sound, on entering the bladder, passed over the calculus towards the fundus. I have no doubt that if the finger had been introduced into the rectum when the

child had been previously sounded, the stone would have been felt.

The other case was that of a boy, five years old, in whom I distinctly felt a stone on the first examination; but on repeating it a month afterwards I was unable to detect the calculus. The child was sounded by one of the most experienced lithotomists in the metropolis; but, after a careful examination, he could not detect a stone. After waiting three months, I sounded the child again, and at the extremity of the sound, towards the fundus of the bladder, I felt the stone. The operation was then performed, and a mulberry calculus, weighing one drachm and forty-three grains, was removed. The operation revealed the cause of the difficulty: the bladder was very capacious for a child of his age, and the stone was situated at its fundus. I could not touch the stone, as in ordinary cases, with my finger, nor seize it with the forceps, until pressure had been made over the bladder, and the child's body raised.

In a case in which Sir B. Brodie operated, he could discern no stone when he first introduced his finger into the bladder; at last he felt it on the anterior part of the bladder, behind the pubes. It was not lying loose in the cavity of the bladder, but evidently contained in a cyst, communicating with the bladder by a round opening. By means of a probe-pointed bistoury, he carefully dilated the orifice of the cyst, and then, introducing his finger, separated the membrane from the calculus until he was enabled to take hold of the stone with the forceps. It was both encysted and adherent, for it was brought away with a portion of the mem-

branous lining of the cyst closely attached to it. The boy recovered, and the calculus is preserved in the museum of St. George's Hospital.

Cysts or pouches are sometimes formed by the protrusion of the mucous membrane between the muscular fibres of the bladder, into which calculi, that had been loose in the bladder, and could be easily recognised with a sound, find their way, and cannot afterwards be felt; or it may happen, that when such a pouch exists, the calculus may sometimes be contained in it, and at other times makes its escape into the bladder, a peculiarity which will readily account for a calculus being sometimes easily felt, and at other times not felt at all. Sir B. Brodie relates the following case illustrative of this condition of the bladder. "The case is, in many respects, remarkable. I discovered a stone in a gentleman's bladder; but he was advanced in years, and as, for the most part, he suffered very little inconvenience from the disease, he did not wish to go through any dangerous operation for the sake of obtaining relief; nor did I think it right, considering all the circumstances, to urge him to submit to it. He went on, in general suffering little or nothing. He was a convivial man, dining a great deal in society, as if he had no ailment. Every now and then, however, he was suddenly seized with the usual symptoms of stone in the bladder, and very severe ones too; he then sent to me. I kept him in the horizontal posture, prescribed him an opiate clyster, and in the course of a few days, sometimes sooner, sometimes later, the attack subsided; he was again at his ease, and enabled to return to his usual habits. I had been occasionally in attendance on him for three or four years, when he was seized with a

severe cold, which ended in a pleurisy, of which he died. On examining the body, I found the stone imbedded in a cyst near the fundus of the bladder. The cyst was formed, in this case, not by the protrusion of the mucous membrane between the muscular fibres, but by a dilatation of both tunics of the bladder, the muscular as well as the mucous. The stone was not so closely embraced by the cyst as to prevent it occasionally slipping out of it; and I suspect that this actually happened, and that it was when the stone lay in the cyst that the patient was free from the usual symptoms of calculus, and that his sufferings took place when the stone escaped from it into the general cavity of the bladder." Again, the bladder may ulcerate, and the stone either wholly or partially escape.

The causes of the difficulty in detecting stone in the bladder may be arranged under the following heads:

1. Enlargement of the prostate.
2. Fungous growths at the neck of the bladder.
3. Other morbid conditions of the bladder, as cysts, fungus, polypus, &c.
4. Certain peculiarities in the situation and size of the the stone.*

When a fungous growth exists at the neck of the bladder, it must offer great obstacles to the detection of a calculus, and when the stone becomes encysted an insurmountable source of difficulty exists. In other cases of difficulty, attention to a few practical rules will much assist us. In examining persons with enlargement

* I purposely exclude such a contracted state of the urethra as prevents examination of the bladder with the sound.

of the prostate, who are suspected to labour under a stone, a sound of the shape and curve of the lithotrite is certainly better fitted than the sound in common use for reaching the *bas-fond* of the bladder, the probable situation of stone in these cases. Mr. Crosse* mentions that Mr. Pearson occasionally used a catheter of this shape, and found it enter the bladder when an instrument of a different shape would not. No examination of the bladder, when the prostate is enlarged, should be considered complete, in which an instrument of this shape (provided the stone is not felt with the common sound) has not been employed. Again, the introduction of the finger into the rectum is an auxiliary, which, especially in these cases, and indeed in most other difficult cases of stone, should not be neglected. It is singular that M. Civiale, whose experience in calculous affections is so great, should speak so lightly of this mode of examination.† In one of the cases which I have related, the

* Treatise on the Formation, Constituents, and Extraction of Urinary Calculus, p. 55, 4to, Lond. 1835.

† "En effet, veut-on explorer la partie prostatique de l'urètre et le col vesical? le doigt se trouve séparé de la partie malade par un plancher épais, dur et résistant, à travers lequel le tact de plus délicat ne saurait rien discerner. S'agit-il d'atteindre la pierre située dans le bas-fond de la vessie? pour peu que la prostate soit engorgée, et même alors qu'elle ne l'est pas, le doigt ne saurait arriver jusque là; sa pulpe appuie sur la face inférieure de la prostate, et rarement elle s'etend au bord posterieur, entre les vesicules séminales et les conduits spermatiques; les cas dans lesquels il serait le plus facile de palper cette région de la vessie sont précisement ceux où l'on n'a aucun intérêt d'introduire le doigt dans le rectum."—*Traité de l'Affection Calculeuse*, p. 476.

stone could not be felt with the sound, until the finger was introduced into the rectum, and the operation was almost on the point of being abandoned. Mr. Crosse says, "I should deem myself as little justified in omitting this method of exploration as in operating without having sounded at all."

In children and grown up persons with irritable bladder, the contraction of the organ renders it difficult to detect the calculus. In this state it is desirable not to examine the bladder in an empty state; and if this organ be irritable, the irritation should be subdued by appropriate means, to enable the bladder to contain a fair quantity of urine. In one of the cases which I have detailed, I have little doubt in my own mind that the fear of the operation caused the escape of the urine, and that the stone was consequently embraced by the folds of the bladder, and could not be felt. When the operation was performed, the boy had no previous knowledge of what was to take place, for I was in a state of uncertainty myself, from what had occurred, whether I should be able to feel the calculus. In the third case which I have given, the situation of the stone was the cause of the difficulty in detecting it. If a calculus be situated behind the pubes, or be adherent to the fundus of the bladder, or be impacted in the vesical extremity of the ureter (one portion being within the ureter, and the other projecting into the bladder, as occurred in a case of Dr. Prout's), great difficulty will be experienced in detecting the stone. In suspected cases of this kind, the patient should be examined in various positions, and the bladder should contain a moderate quantity of fluid. Again,

the small size of a stone may render it difficult of detection; and the best surgeons may then use the sound several times before they can be satisfied of its existence. In the forty-third volume of the 'London Philosophical Transactions,' Mr. Nourse relates the case of a patient in whom the calculi, nine in number, and contained in six separate cysts, were detected on the first sounding, but never afterwards. Ellerus relates a case in which a stone was contained between the coats of the bladder.

There are preparations showing a sort of hour-glass contraction of the bladder, in which no sound could have passed into one of the compartments.

Müller mentions the case of a boy, in whom the following morbid condition of the urinary organs existed. The prostate was converted into an immense pouch, in which the catheter was arrested and did not pass into the true vesical cavity, in which a stone was lodged. The patient was sounded twice without any stone being discovered. The third time, however, it was detected, and the operation was performed; a large quantity of pus escaped, but no calculus was found. The patient died, and on dissection it was perceived that the bladder had contracted tightly round a concretion the size of a small lemon. The prostate was partly destroyed by suppuration, and presented an enormous cavity, which had been mistaken for the bladder, and into which the instrument had wandered during sounding.

A variety of anomalous symptoms may combine and simulate those of stone. Among such curious cases is one related by Mr. Fenwick, in the 'Lancet,' Jan. 24th,

1846, where an aneurism of the abdominal aorta gave rise to symptoms which misled the surgeons attending the patient. There was violent pain at the extremity of the penis and in the pubic region, during and after micturition; there was pain in the kidneys and epigastrium; the urine was red, and deposited a thick sediment; the tongue was white, and the appetite bad. The symptoms appearing to indicate the presence of stone in the bladder, a sound was introduced, but no calculus could be detected. There was nothing which created a suspicion that the disease was aneurism. The patient, soon after he was admitted into the infirmary at Newcastle-upon-Tyne, died under symptoms of great exhaustion, preceded by sudden fainting. The abdomen was found filled with blood, which had proceeded from the rupture of an aneurism of the aorta, about the size of an orange; it had produced caries of the bodies of the vertebræ on which it rested, and was accompanied by hypertrophy of the left ventricle of the heart and thickening of the tricuspid valves. There was no calculus in the bladder, and no disease in any portion of the urinary organs.

From the preceding remarks it is clear that, though calculi are contained in the bladder, it may be difficult, if not impossible, to ascertain their existence during life; that the bladder may be sacculated; and that an excavation may exist immediately behind the prostate, or on one side of it, in which the stone may easily escape detection. In persons far advanced in years, a secondary cavity, occupying the fundus of the bladder, bounded above by the prostate, behind by the orifices of the ureters, and the intervening portion of the

parietes of the bladder, may contain the stone firmly fixed in it; this state being generally accompanied with ulceration of the coats of the bladder. In other cases the stone may be, as it were, pinched between two folds of the bladder; or be fixed in a cul-de-sac, formed either by a hernia of the mucous membrane in consequence of separation of the muscular fibres, as so often happens in columnar bladders, or by a real cyst round the stone.*

* Velpeau, Médecine Opérative, 2d edit. 1839, tom. iv, p. 484.

CHAPTER XIX.

FOREIGN BODIES IN THE BLADDER.

The number of foreign bodies, besides proper urinary calculi, which have been found in the bladder, is immense. In males and females, hair, beans, and peas, fruit-stones, ears of corn, portions of bougies, nails, bullets, small bones, pins, needles, string, stalks of flowers, &c. &c., have all been extracted from the bladder, these foreign bodies having frequently formed the nucleus of a stone.*

The manner in which they may sometimes find their way into the bladder is curious. In many cases the accident has arisen from an attempt to satisfy morbid desires. Numerous cases of this kind are on record, especially in females; at other times the foreign body is introduced by accident or design. Some time ago my friend, Mr. Haynes Walton, exhibited, at the Medical Society of London, five calculi, which had been removed by Dr. Mackenzie, of Edinburgh. The calculi were of prismatic shape and uniform size. On inquiry it was found that a number of beans had been forced into the

* I would refer the curious on this subject to the 'Dictionnaire des Sciences Médicales,' t. vii, p. 38, and also to M. Civiale's 'Traité de l'Affection Calculeuse,' p. 78.

patient's urethra and rectum by some companions in a drunken quarrel. Each calculus was formed round one of these beans. At other times the foreign body has slipped into the bladder by accident. This is very likely to occur during the use of bougies, catheters, &c., and in a great many instances it has been found that the foreign body was a tobacco-pipe or some cylindrical body, employed by the patient as a substitute for a bougie and for the relief of stricture. Sir A. Cooper once cut a woman for stone which had formed round a female catheter; it was nearly an ounce in weight. Some months previously a surgeon had allowed the catheter to slip into the bladder, but said nothing about the accident for fear of getting into trouble.

Mr. Toogood, of Bridgewater, has published, in the *Medical Gazette,* two interesting cases where a female catheter slipped into the urethra. In both cases the instruments were extracted by dilating the urethra by the sponge-tent, so as to enable the fore finger to be introduced into the bladder.

About two years ago I was summoned to a case in which a female catheter had slipped into the bladder, and after an hour's trial with various instruments, I at last succeeded in laying hold of it with a long straight narrow forceps, and withdrawing it. The late Mr. Key and myself saw, some years ago, a case where three inches of a thin gum elastic catheter broke in the urethra, near to the bladder, and although we were called to the gentleman immediately after the occurrence of the accident, we could not lay hold of the broken portion. Three weeks after the fragments (for there were two, one an inch in length and the other two inches) were voided

by the urethra. Since the publication of the former edition of this work, Mr. N. Ward, of the London Hospital, and myself were summoned to a case in which a male silver catheter broke, and a part of the instrument, five inches in length, made its way into the bladder. With the lithotrite we extracted the broken part without difficulty, and the patient suffered but little from the accident and operation.

The use of gutta percha bougies has recently given rise to several accidents of the kind now alluded to; the substance may possibly be converted into a hydrate, which alters its qualities, and renders it brittle. A remarkable case occurred during the present year (1856) at Guy's Hospital, in the practice of Mr. Cock. The patient, a man forty-six years of age, had been under the care of Mr. Lawrence, at St. Bartholomew's Hospital, in 1854, with stricture, and had been in the habit of wearing a gutta percha bougie; but on one occasion the instrument became tightly embraced by the stricture, and gave way on an attempt being made to withdraw it. Mr. Lawrence made several fruitless efforts, with forceps, &c., to extract the foreign body, a portion of which projected from the bladder into the back part of the urethra. The canal was then incised through the perinæum, but the fragment of bougie again broke, a portion remaining entirely in the bladder. The man was put to bed, and in a few days the fragment escaped spontaneously through the wound, after which the latter healed well.

Eighteen months afterwards this man entered Guy's Hospital from a similar accident. He had again recourse to a bougie of his own manufacture, and broke it a

second time. He supposed that about five inches of the instrument was left in the urinary passages. The urethra was dilated by means of bougies, but no foreign body could be felt; and as the bladder was extremely irritable, Mr. Cock did not deem it prudent to employ the forceps or lithotrite. In a fortnight after the accident, the symptoms had become very severe, the urine contained blood, and ropy mucus with the phosphates; the pain was very great. The operation for lithotomy was therefore performed, but the division of the prostate was limited, being just sufficient to allow the introduction of the little finger. Three separate portions of bougie coated with phosphatic deposit were extracted with a small forceps; they made up about five inches, and evidently constituted the whole of the retained fragment. The wound progressed favorably, and was completely healed before the expiration of a month.

About the same time a similar case occurred in the practice of Mr. Callaway. The patient had been addicted to onanism, and introduced a cylindrical piece of French chalk, about an inch and a half long, into the urethra. It got into the bladder and excited great irritability of that organ, the patient making water every quarter of an hour with pain. A vertical incision was made through the raphe, and the membranous portion of the urethra opened—but still no body could be felt; the wound was therefore enlarged until the finger could pass into the neck of the bladder and dilate it; a small pair of lithotomy forceps was now introduced, and the foreign body removed. The patient did well.*

* Medical Times, Aug. 30th, 1856, p. 213.

In a third case, observed by Mr. Hutchinson, the fragments of a gutta percha bougie came away spontaneously. The circumstances under which this occurred are worthy of attention, all attempts to discover the foreign body failed; the urethra was therefore dilated, and the bladder afterwards injected with warm water to distension, until it began to rise above the pubes. About one third of the quantity was at once rejected by micturition, in a full stream, but nothing else came away; in six hours, however, he again made water, and felt something in the perinæum; on kneading this body forwards, he succeeded in removing a fragment about an inch long. The same fortunate accident occurred five hours afterwards, and again the patient was enabled to push forwards a fragment and remove it as before. The two fragments were nearly three inches in length, and were thinly coated with phosphates.* It is proper to observe that, in these three cases the bougies had been imperfectly manufactured by the patients themselves and not by an instrument-maker.

The course to be pursued, when foreign bodies, and especially fragments of bougies, &c., are retained in the bladder, is indicated in the preceding cases. The most favorable termination is, of course, that in which the foreign body is expelled spontaneously. Hence, whenever circumstances will permit, when the symptoms are not urgent, and the foreign body may be presumed to be of moderate size, Mr. Hutchinson's practice is worthy of imitation. The canal of the urethra should be dilated, and the bladder distended by injections.

* L. c., p. 213.

The change in the form of the bladder, produced by forced distension, is a circumstance which permits the elongated body to present itself at the neck of the organ, in a position best calculated to promote its passage into the urethra.

In other cases, when the end of the foreign body projects through the neck of the bladder into the urethra, an attempt should be made to extract it by means of Weiss' instrument for the removal of urethral calculi.

The surgeon familiar with lithotrity, is evidently the most likely to succeed in attempts of this kind; and hence we are indebted to M. Civiale for the most detailed account of the manner in which these foreign bodies may be removed from the bladder. The following remarks are condensed from his work on 'Lithotrity.'* M. Civiale has recourse to lithotritic instruments for the extraction of such foreign bodies as admit of being removed in this manner, and with them he has at various times extracted a haricot bean, a pea, corn beards, stems of plants, bougies, pieces of wood, and a barometer tube. In most of these cases, the operation presented much less difficulties than might have been anticipated, while the pain was not excessive.

Generally speaking, the patient can sufficiently explain the nature of the body which has been introduced into the bladder; but its shape, size, and consistency, may be modified by its sojourn in that organ, phosphatic concretions almost always forming round it.

* Traité pratique et historique de la Lithotritie. Bailliere, Paris, 1847, p. 233.

"The bodies may be distinguished into three kinds. Some are small and oval, more or less soft, and capable of being flattened or extracted whole. The second kind is composed of flexible bodies, as bougies, &c. In the third species we have long inflexible substances which can only be extracted in the direction of their long axis.

With the first class the great difficulty is to lay hold of the foreign body; and for this purpose M. Civiale prefers his three branched instrument. In employing it, care must be taken to close the branches on the foreign body, by pushing forward the sheath, not by drawing back the branches. The reason of this precaution is obvious. In certain cases, a curved lithotrite with broad flat blades may be employed; from one to two ounces of fluid having been previously injected into the bladder.

Flexible bodies of the second class may often be seized and extracted with a small lithotrite; as the flexible body bends, great caution is required, the operator being necessarily ignorant of the manner in which the foreign body may be placed between the blades of the instrument. For long and inflexible bodies, the three-branched instrument is preferable; but it must be confessed, that even with the most perfect instruments and practised skill, the operation in these cases is both tedious and difficult.

Should these measures fail, or not be deemed applicable, an operation somewhat similar to that of lithotomy should be performed without any further delay. The phosphates are deposited on the foreign body with surprising rapidity in some cases, and it is always danger-

ous to wait too long. Delay is attended with two bad consequences: it gives time for the formation of calculous deposits, and it increases the risk of disease of the bladder or kidney, whereby the danger of any operation subsequently necessary must be greatly augmented.

Hydatids have been discharged from the urethra, and after death numbers of them have been found floating loose in the bladder. In such cases, it is most probable that they have descended from the kidney, along the ureters, or that they have been introduced into it from a cyst formed in the pelvis, which had opened by ulceration into the bladder. Worms also have been discharged with the urine, an instance of which is related by Mr. Lawrence in the 'Medico-Chirurgical Transactions.'

Mr. Curling * has given an account of some worms which he discovered in the urine, and which do not appear to have been before described. The urine in which the worms were contained was high coloured and slightly acid. It was observed, that when first passed, they floated separately in the urine; but in a short time they coalesced, and coiled themselves up together in the form of a ball at the bottom of the vessel, and it was with difficulty that they could be separated. When they were disturbed, their motions were often very lively; and if allowed to remain in the urine, they lived for two or three days. They were very transparent, so that the contents of the alimentary canal could easily be distinguished by the naked eye. On

* Med.-Chir. Trans., vol. xxii.

immersing them in spirits of wine, they soon became white and opaque. They were of two sizes, the larger worms being more numerous than the smaller.

A slight examination at once convinced Mr. Curling that these worms could not belong to any of the species of entozoa at present known to infest man: and considering the period of the year, he was at first induced to imagine that they must have been the lava of some insect. On placing one in the field of a microscope, he recognised a beautiful organization and true nematoid structure, and on reference to Rudolphi's 'Synopsis Entozoorum,' and other works on this subject, discovered that it was an entozoon, which had not hitherto been described.

Several instances of hair voided with the urine are mentioned by Sir Hans Sloane; one particularly of a brewer, who suffered from the passage of long hairs, matted or woven together, passed with great pain, but with little or no calculous matter attached to them. Mr. Powell relates a case of a middle aged lady, who after being teased with disordered stomach and bowels, and evacuations of whey coloured and fetid urine, passed little masses of hair mingled with a peculiar viscid mucous substance, partially crusted with calculous matter. The excretion of these masses was attended with aggravation of the distress and pain in the bladder, from the urine bringing them into contact with the orifice of the urethra. The complaint, which in this case continued long, induced great weakness and much wasting of the body. Dr. Wallace also met with an instance in which hair was several times voided with the urine; and on the body being examined after death, a

stone was found in the bladder, as large as a goose's egg, from parts of which hairs had grown out. It was thought that the hairs voided during life, which were a great many, and some of an extraordinary length, grew out of that stone; because when the hairs hung out of the urethra, as they frequently did to the great torment of the patient, they were obliged to be pulled out, which was always done with a resistance, as if plucked by the root.*

* Howship, op. cit., p. 167.

CHAPTER XX.

LITHOTRITY.

Various efforts have been made, from time to time, to supersede the serious, and before the introduction of chloroform, the painful operation of lithotomy.

All these attempts, however, failed in their object, and the removal of stone by cutting into the bladder was the only effectual mode of getting rid of the complaint, until the discovery by M. Civiale of the operation which I am about to describe, viz., that of breaking up the stone in the bladder so as to allow of its discharge by fragments through the urethra.

Having fully considered, in another work,* the historical part of this interesting method, I shall omit it here, and pass at once to practical matters.

Lithotrity is not suited to all cases of stone; its successful application will mainly depend on its being only employed in such cases as are suitable for this mode of operating. I shall point out the indications, or contra-indications of the operation, at the close of this chapter;

* Lithotrity and Lithotomy. Churchill, London, 1853.

for the present I will assume that the subject about to be operated on does not present any conditions which would render lithotrity improper. These conditions are ascertained by a careful examination of the general health, and of the state of the urinary organs in particular. Having decided the propriety of the operation, the next point to be considered is, whether it be necessary that the patient should undergo what is called preparatory treatment.

When the calculus is small, the bladder healthy, and the urinary passages show little signs of irritability, I do not regard preparatory treatment as necessary. In most cases, however, it will be prudent to correct any unfavorable conditions which may exist, before proceeding to operate. Thus, the digestive organs must be attended to, and any derangement of the intestinal secretions improved as far as possible. Irritability of the bladder must be relieved by opiates, &c.; in a word, urgent symptoms must be alleviated or got rid of. It is the more necessary to attend to these points, because, before proceeding to operate, the surgeon should, by a careful examination of the urinary organs, obtain some notion of the capacity and contractile power of the bladder; the size of the stone; the condition of the prostate; in a word, of various circumstances connected with the substance on which he is about to operate, and of the organs that enclose it or give passage to his instruments. Should the examination have given rise to any degree of irritation, it will be prudent to defer the operation until such irritation has subsided.

Before operating, however, an important question presents itself. Should the patient be submitted or not

to the influence of chloroform? M. Civiale and Sir Benjamin Brodie have both pronounced against the use of chloroform in lithotritic operations. The feelings of the patient are a most useful guide in two essential matters; they serve to indicate whether an injury is being inflicted on the soft parts, and they assist us in determining whether the operative proceedings are continued beyond what the bladder and constitution are capable of enduring. On the other hand, the use of an anæsthetic agent is attended by many palpable advantages. I have formerly announced the opinion that chloroform should not be employed in cases of lithotrity, but I must confess that a more enlarged experience has induced me to modify this opinion considerably; as a general rule, I still hold to it, but it admits of many exceptions. Children are so unmanageable that they should be rendered insensible when submitted to lithotrity; and in the female also several advantages will be gained by chloroform. In males of a nervous temperament, and who cannot bear the least pain, the use of chloroform is of great service throughout the whole of the sittings. In cases also where the stone has been partly crushed without the aid of chloroform, and great irritability of the bladder supervenes, chloroform may become indispensable in the subsequent operations. A remarkable instance of this kind has recently occurred in my own practice. A gentleman, æt. 52, in whom I had crushed a lithic acid calculus several times, without the aid of chloroform, suffered after a time so severely from irritation of the bladder, that malignant disease of the organ was supposed to exist. On examination of the bladder without the aid of chloroform, no stone could be

detected. The symptoms becoming more severe, I determined—with the consent of Dr. Peacock, who had the medical charge of the case throughout, and to whose skilful watching the patient owes much of his recovery—to examine the bladder under the influence of chloroform. This was done, when a large calculus, with lithic acid nucleus, covered with the phosphates, was readily seized and crushed. The operation has been repeated four times under chloroform, and the patient is, I hope, cured.

In the examination of the bladder, at the close of the treatment, for the purpose of ascertaining whether any fragments remain, I have sometimes derived great assistance from the use of chloroform.

The instruments employed during an operation of lithotrity are not many. They consist in an ordinary catheter to draw off the urine, an injecting syringe, and the lithotritic forceps. In addition to these we require a large eyed syringe, for washing out the bladder after the operation, and assisting in the discharge or removal of detritus. Generally speaking, the bladder will bear five or six ounces of fluid without distress; but in old cases of stone the bladder is often thickened from chronic inflammation, contracted and extremely irritable. As soon as a few spoonsful of fluid are thrown in, the bladder contracts and ejects the fluid, obstinately refusing, as it were, to dilate. In these cases the pelvis should be well raised on pillows, and an attempt made to repeat the injection in an extremely slow and cautious manner, gradually feeling the way as the bladder yields; a small quantity of fluid may be then thrown in, and the patient allowed to repose a little, when a fresh quantity is injected. Should the irritability of the

bladder continue, we must cease all attempts till another time.

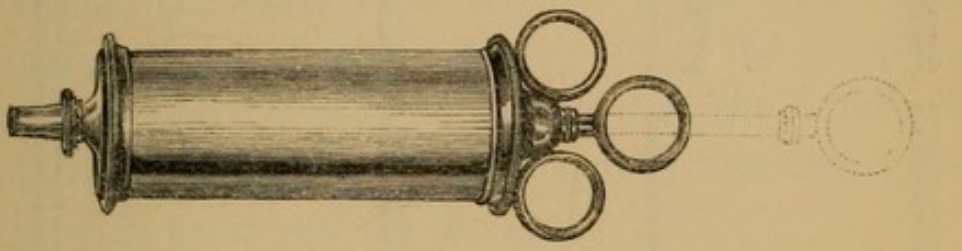
Sir Benjamin Brodie informs us that the power of the bladder to retain the fluid may always be restored by keeping the patient in a recumbent posture for seven to fourteen days, and daily injecting some water into the bladder.

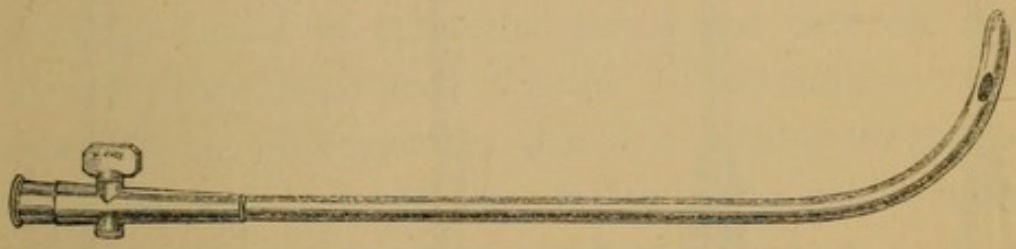
The position of the operator and the patient is of much importance. The patient is to be placed on his back on a bed or couch, with the pelvis slightly raised by an unyielding cushion, so as to bring the most depending part of the bladder on a line with the internal orifice of the urethra. The head and shoulders should be supported by pillows, so that there be no strain on any part of the body, and the patient may feel himself at ease. The legs of the patient are to be separated, and the thighs slightly flexed. I always place myself on the right side of the patient, as my movements are much freer in this than in any other position.

Everything having been prepared, a common catheter is now introduced into the bladder, and the urine drawn off. The quantity of urine which comes away enables the surgeon to form some estimate of the quantity of tepid water which may be injected into the bladder. This will vary in different cases, according to the capacity and irritability of the bladder; generally speaking, four to six ounces will be sufficient. The instruments employed for injecting the bladder, are a full-sized silver catheter, fitted with a stop-cock and a metallic syringe capable of holding about half a pint, and of being accurately fitted to the stop-cock.

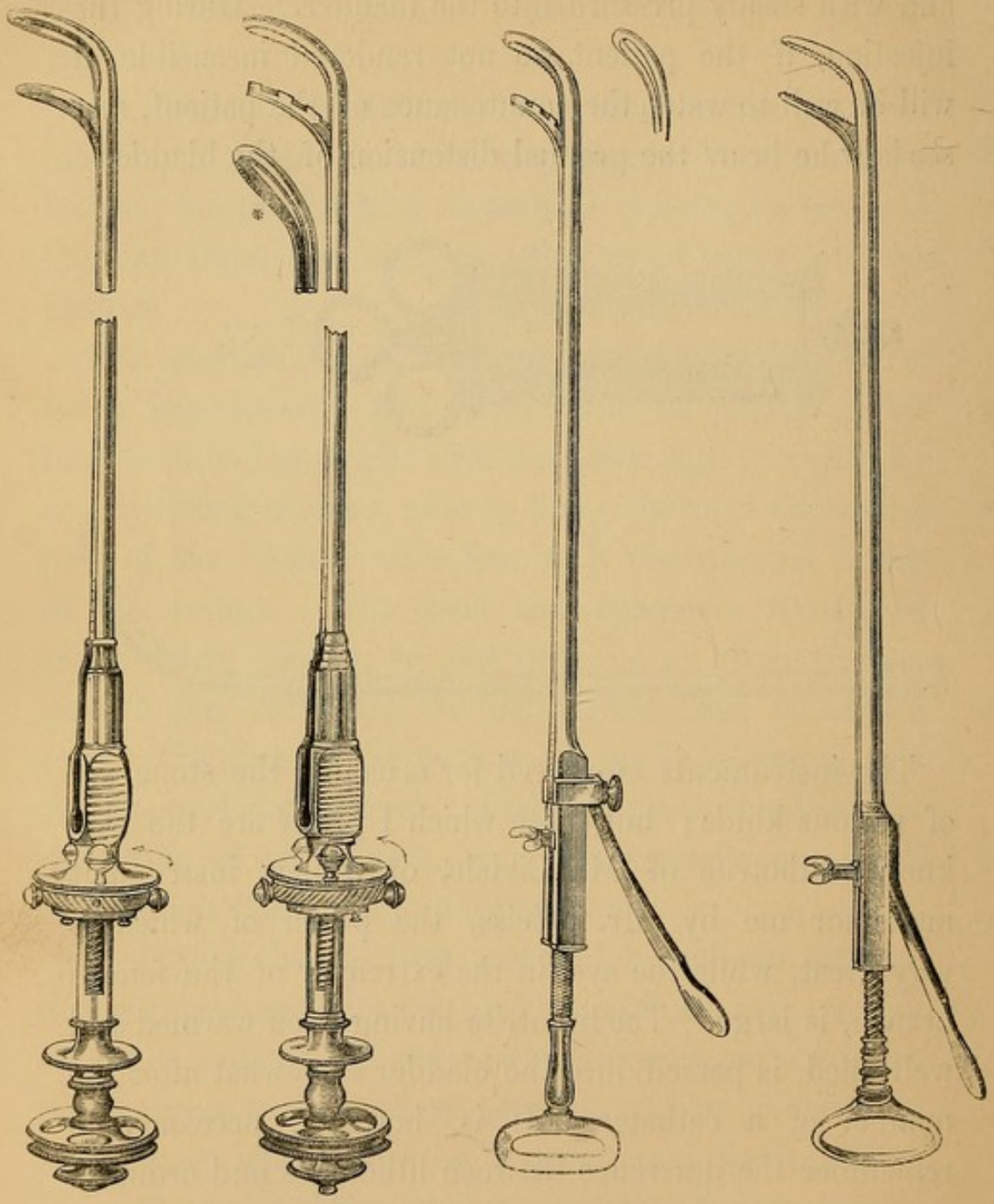
The necessary quantity of fluid is now injected slowly

and with steady pressure into the bladder. During the injection, if the patient be not rendered insensible, it will be well to watch the countenance of the patient, and see how he bears the gradual distension of the bladder.





The instruments employed for crushing the stone are of various kinds; but those which I prefer are the well known lithotrite of M. Civiale, or a new instrument made for me by Mr. Weiss, the power of which is very great, while the eye, in the extremity of the female branch, is large. The lithotrite having been warmed and well oiled, is passed into the bladder somewhat after the manner of a catheter. It is, however, necessary to remember the difference between lithotrites and ordinary sounds. The elbow of the lithotrite is very abrupt, not having the arched curve of the catheter, while the ascending portion is short. These two circumstances must be taken into account, as soon as the instrument reaches the curved portion of the urethra. The main point to bear in mind is that the extremity of the instrument should follow the natural curves of the urethra, and hence, when the instrument has arrived at



CIVIALE'S LITHOTRITE. COULSON'S LITHOTRITE. WEISS'S LITHOTRITE. SCREW SCOOP.

the bulbous portion of the urethra, its handle must be brought slowly down to a right angle with the body of the patient. This brings the extremity of the lithotrite into the direction of the canal under the pubic arch, after which the instrument is advanced in a slow

and gradual manner, until the point has entered the bladder. By a slight rotatory movement of the lithotrite, we may always be sure when it is in the bladder. The amount of depression, while the extremity of the instrument is passing under the arch of the pubes, will depend on its curve, and on the length of the ascending branch; when the prostate is enlarged, the handle of the instrument must be proportionately depressed, so as to throw its point over the elevation.

It is almost unnecessary to mention that the proceedings should be conducted slowly and in a cautious manner; there is no need of haste. The young operator especially should remember that it is possible to lacerate the lining membrane of the urethra at the membranous portion without any great amount of force.

The lithotrite being in the bladder, our next step is to find and seize the stone. There is some difference of proceeding as applied to small or large calculi. When the stone is of moderate size, there is seldom much difficulty in this part of the operation. The calculus is soon found on the floor of the bladder or at the side towards which the patient may be inclined. While seeking for the stone the instrument is to be kept on the same plane as when it entered the bladder, and the blades are to be separated from each other about half or three quarters of an inch. The instrument is held lightly between the thumb and fingers of the left hand, which are applied to the square and round portions of the female blade, the back of the hand being directed upwards; whilst the handle of the male blade is held by the thumb and first two fingers of the right hand.

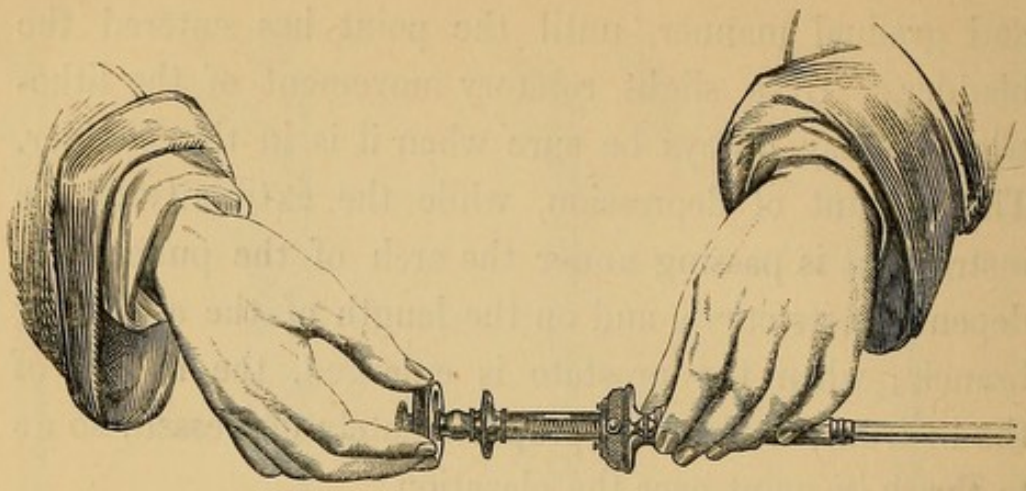


FIGURE SHOWING THE LITHOTRITE HELD IN THE MANNER JUST DESCRIBED.

The instrument is then made to revolve slowly, with the blades a little open. This revolution is effected by movements of the thumb and two fingers of the left hand, as if we were revolving a pencil or any cylindrical body between them. It is made at first to one side, say the right, and while this is being done the male branch is at the same time gently moved forwards and backwards several times to the extent of half or three quarters of an inch. The object of these movements is, that the male branch may meet the stone, which it generally does while traversing over the different spaces. If the stone be not caught in this situation, the instrument is rotated, in the same way, on the opposite side of the bladder, the male blade being moved forwards and backwards as before. The whole of the floor of the bladder, with the exception of its central part, is thus explored, and if the patient has been a little inclined to the right side, (a position I usually adopt), the stone will in most cases be caught with ease on the right side of the floor of the bladder.

Let us suppose, however, that the calculus is not

discovered in either of the situations mentioned; that it lies in the centre of the floor, or just behind the prostate, which is probably somewhat enlarged. In a case of this kind an attempt may be made to dislodge the stone by elevating the pelvis more than in ordinary cases. The mere change of position may displace the calculus and enable us to seize it. Should this, however, fail, we must have recourse to the following proceeding. The revolution of the instrument, which in the two cases formerly spoken of was such as only to command the sides of the floor, is continued, until its point and the concave surface of the blades are directed immediately downwards; at the same time the handle of the instrument is slightly elevated so as to bring the end into the hollow behind the prostate, and thus command the central portion of the floor of the bladder. The male branch is again moved to and fro, as before, until the stone is caught or fished up from the depression in which it lay, behind the prostate. The manipulation is easily and safely performed, and M. Civiale has recourse to it in almost every operation which he performs, in order to seize any fragments that might have escaped the instrument during its lateral revolutions. It is particularly necessary when the calculus is lodged in a depression behind the prostate. A case of this kind recently occurred to me in a patient of Mr. Read, of Kensington. The stone lay almost embedded in this situation and could not have been seized, I believe, by any other manœuvre than the one which I have just described.

While fixing the stone between the blades of the instrument, it is a matter of importance to remember that

the female branch should be kept perfectly immovable while the male branch is being driven forwards to close on the stone. Unless this be done, we run the risk of displacing the calculus, which generally lies against the ascending branch of the female blade. It is also right that the calculus, unless large, should be seized as nearly as possible towards its centre.

Sir Benjamin Brodie, Mr. Skey, and many other able surgeons, employ a different method of seizing the stone. Sir Benjamin Brodie directs that the convex part of the curved extremity of the lithotrite should be brought into contact with and gently pressed against the posterior and lower surface of the bladder, by the elevation of the handle; the effect of this pressure is to convert the floor of the bladder into a narrow cavity into which the stone falls by its own weight, generally coming into contact with the female branch of the open blades: should this not occur, the instrument may be slightly struck on one of its sides, and the slight concussion will probably dislodge the calculus from its fixed position and cause it to fall within the grasp of the instrument. Mr. Skey recommends, also, "a smart blow with the open hand of the surgeon against the pelvis of the patient," and says "this *coup* will succeed again and again, and may be repeated so long as there remains stone to be broken."

When the calculus is large, the surgeon has little difficulty in finding the stone, but it may not be so easy to seize it. In such cases, M. Civiale recommends us to apply the two branches of the instrument, slightly separated, on the surface of the stone; they are then more widely separated, by drawing one branch forwards and

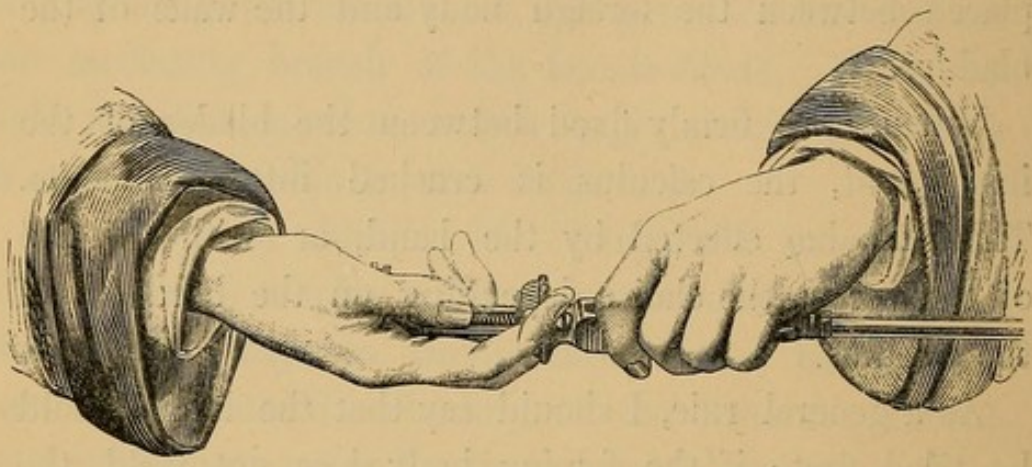
pushing the other backwards, until they reach the edges of the foreign body. The instrument, thus opened, is pressed laterally on the stone, until its branches become placed between the foreign body and the walls of the bladder.

When once firmly fixed between the blades of the instrument, the calculus is crushed into fragments. This may be effected by the hand, or with the aid of the screw, the choice depending on the hardness of the calculus.

As a general rule, I should say that the hand should be tried first; if the foreign body does not yield, the screw can be brought into play. When pressure with the hand is adopted, the following manipulation becomes necessary. The female branch is held firmly by the left hand, applied to the square portion; the circular projection immediately behind this square part is embraced between the index and middle fingers of the right hand, which are hooked on it, and use it as a *point d'appui;* the extremity of the male branch rests in the palm of the same hand, the palm being turned upwards. In this position, by strongly contracting the flexor muscles of the fingers, the male branch is driven forwards on the stone, when the latter, if not too hard, is readily broken up by a few contractions of the kind mentioned.

Should the stone not yield to this action of the hand, nothing is easier than to bring the screw of M. Civiale's instrument into action. The catch is turned from right to left. By a peculiar mechanism, this allows the screw to act, and its action is developed by simply turning

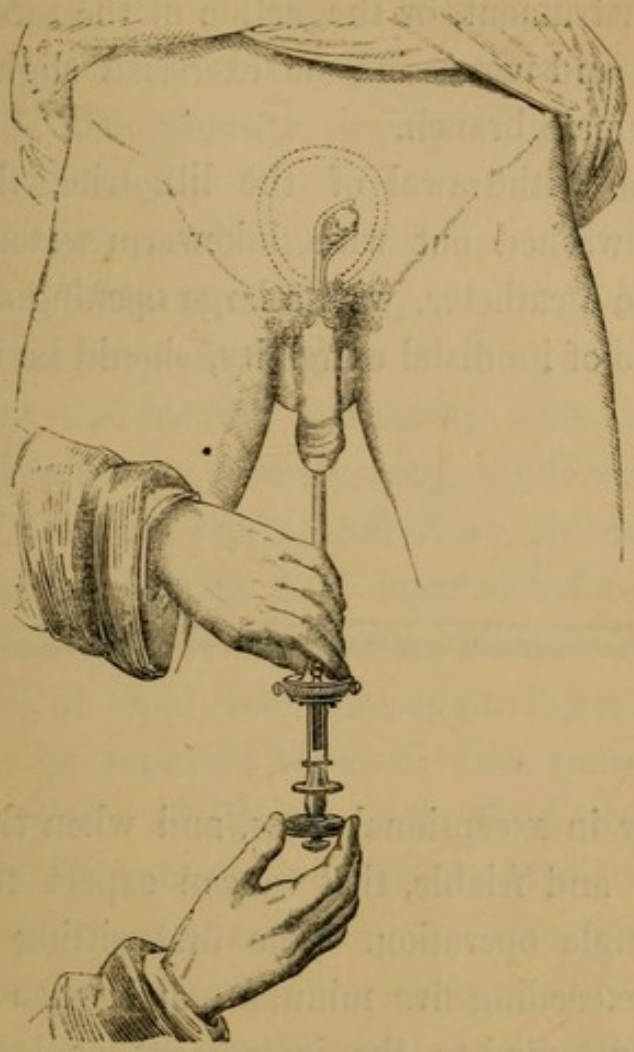
from left to right the wheel attached near the extremity of the male branch.



THIS FIGURE SHOWS THE POSITION OF THE HANDS IN CRUSHING THE STONE WITHOUT THE AID OF THE SCREW.

It has, however, occurred to me on four occasions, that I have been unable to crush the stone with the screw of M. Civiale's instrument, and in consequence was obliged to abandon the operation, to resume it at another time with Weiss's screw lithotrite. These failures led me to devise a new lithotrite, on the principle of M. Civiale's; it possesses power sufficient, I think, to crush any stone.

Before withdrawing the instrument from the bladder, it is absolutely necessary to ascertain that the branches are perfectly closed, and that no fragments of the stone or detritus are retained between the blades. On looking at the scale marked on the handle of the instrument, we shall see at once whether the blades are closed, or to what extent they are separated. It is scarcely necessary to say that any increase of the size of the instrument, or the projection of any angular fragments between its

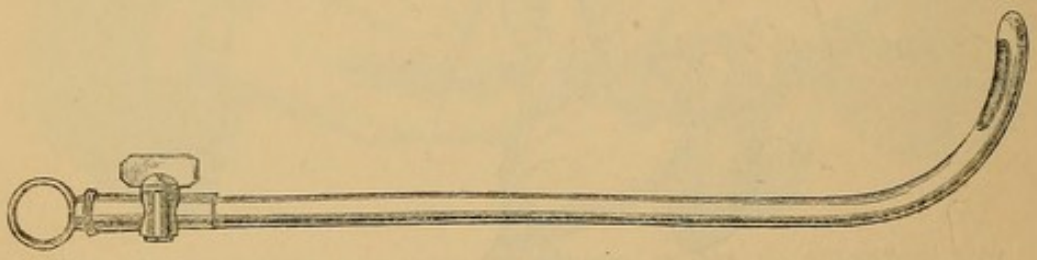


THIS FIGURE SHOWS THE STONE BETWEEN THE BLADES OF THE LITHOTRITE, THE SCREW OF THE INTRUMENT BEING IN ACTION.

blades, might produce serious injury to the neck of the bladder, and narrow parts of the urethra, while the lithotrite is being withdrawn. The eye or vacant space in the ascending portion of the female branch, in my instrument and Weiss's ordinary lithotrite, is left, for the purpose of avoiding the accumulation of detritus which escapes through the opening; but in the French instrument there is no eye. It requires several movements of the screw to get rid of the detritus from the scoop, but the detritus must be got rid of. A few turns of the screw backwards and forwards will usually suffice to

clear the instrument, or the action of the screw may be suspended, and percussion be exercised slightly on the end of the male branch.

After the withdrawal of the lithotrite, the bladder should be washed out with lukewarm water; and for this purpose a catheter, with a large opening on the concave surface of its distal extremity, should be used.



It is only in exceptional cases, and when the stone is both small and friable, that we can expect to break it up at a single operation. The first sitting should be short, not exceeding five minutes; and when the organs become accustomed to the instrument, or less irritable, the operation may be prolonged for ten minutes at a time. This is a rule from which we should never deviate. From three to eight days should elapse between each operation, to allow the fragments to pass away with the urine, and any irritation which the operation may have excited to subside.

Such fragments of the calculus as are too large to come away with the urine, must of course be treated as distinct calculi, and crushed separately.

The reduction of the calculus into fragments does not complete the work of the surgeon. The discharge of these fragments, and of the detritus, must be promoted with the least possible delay. Upon this point I would

lay great stress, for experience has convinced me that nearly all the consecutive accidents of lithotrity are determined by the quantity or irritating nature of the detritus, which may be left behind in the bladder after the first operation, and which this organ has been unable to expel. The most simple, and, at the same time, effectual mode of promoting the discharge of detritus, is washing out the bladder repeatedly with tepid water. Immediately after the first crushing, a full-sized metallic catheter, of the kind represented above, should be passed into the bladder, and the fluid injected before the operation be drawn off. Some detritus will now come away; a few ounces of tepid water are again injected, and the process may be repeated three or four times, until the patient complains of fatigue, or the fluid which escapes from the bladder ceases to contain any detritus. In a few days, or sooner, according to circumstances, the injections are to be had recourse to again. Sir Benjamin Brodie advises that, in elderly persons with enlarged prostates, the bladder should be washed out daily, and they should be directed to make water in a stooping posture. In detention of detritus from want of expulsive power, we should first endeavour to excite the contractile power of the bladder by throwing into it various quantities of fluid; if this fail, or should the condition be connected with mechanical obstacles, we must have recourse to the scoop, catheter, forceps, or some instrument of the kind, whereby the detritus is removed.

Obstacles to the ready performance of the operation often occur; and unless these obstacles be overcome with judgment and dexterity, various unpleasant or even

fatal accidents may result. The obstacles to lithotrity may be distinguished into four kinds, for anything will create a difficulty which impedes the introduction of the instrument, seizing the stone, manipulating in the bladder, and the subsequent discharge of the detritus. The effects of strictures, &c., in contracting the canal, and impeding the introduction of the lithotrite are obvious. In other cases, the same obstacle arises from a morbid degree of sensibility in the urethra and neck of the bladder.

These parts are excessively sensitive in many calculous patients, while the bladder is at the same time endowed with increased contractility. Should these conditions depend on organic disease of the prostate or bladder, it will be prudent to abstain from operating. When they are merely nervous, appropriate remedies will often relieve the nervous sensibility, and the operation may be had recourse to, but with great caution. Should severe rigors, followed by fever, or nervous symptoms supervene, the operation must not be persisted in.

Excessive contractility of the bladder is another obstacle of a serious nature, and which it is often difficult to overcome. Unless the bladder can be made to retain two or three ounces of fluid, we ought to give up all thoughts of crushing the stone, rather than run the risk of exciting fatal symptoms, by operating in an empty and a disordered organ.

Enlargement of the prostate not only impedes the easy introduction of the lithotrite, but its working in the bladder; still, we are not to conclude that every degree of prostatic enlargement presents an insuperable obstacle. Each case must be judged according to its own

merits. Slight enlargement of the prostate is certainly no great impediment; on the other hand, when the prostate is considerably enlarged, all the circumstances of the case must be carefully considered; and, on the whole, I would conclude that it is better to abandon lithotrity in those cases where the enlargement is of such a nature as to render it probable that the operation may be long, or attended with any considerable difficulty.

The condition of the bladder itself may present certain obstacles which must be taken into account. In many old cases of stone the bladder is hypertrophied, the fleshy columns project from its surface, while the organ is at the same time much contracted, and very irritable. There is no room to work in a bladder of this kind, and this state is extremely unfavorable. I should prefer lithotomy in such cases. The sacculated bladder presents another serious obstacle to the performance of lithotrity. When the calculus is firmly impacted in, and more or less covered by the sac, it is difficult to understand how injury to the mucous membrane of the bladder can be avoided; yet a few cases are recorded in which it is presumed that encysted stones were successfully crushed, from the circumstance that the detritus had always to be sought for at a particular spot in the bladder.

The size and consistency of the stone are the last points to be noticed. When the calculus is beyond a certain size, it cannot evidently be seized by any instrument; but beyond this it is difficult to lay down any absolute rule as to the exact size of the calculus, which renders lithotrity inadvisable. The consistency of the foreign body must here be taken into account, as well as its size. Phosphatic calculi, of any size, are easily

broken up, provided they are not too large to be seized. Even when the stone measures an inch and a half to two inches and a half, it may be crushed, provided it be not very hard, and the urinary organs be free from disease.

Mr. Massey, of Nottingham, crushed two uric acid calculi, the detritus of which weighed about two and a half ounces; Mr. Cæsar Hawkins also operated on a patient seventy-five years of age, the detritus amounting to the same weight of two and a half ounces.

Mr. Key says, "I know of no limit to the size of a calculus removable by lithotrity, but the power of the lithotrite. If a powerful instrument can be brought to embrace it, and the bladder be healthy, the operation may, as far as my experience goes, be attempted with propriety."

Excessive hardness of the stone is no absolute impediment to the performance of the operation, although it may be a counter-indication. There is no stone, however hard, which I believe could resist the power of the new instrument made for me by Mr. Weiss.

The accidents which sometimes supervene in the operation of lithotrity are, if we believe some authors, numerous and severe. M. Velpeau, who has always been hostile to lithotrity, enumerates no less than twenty-nine accidents occurring after this operation. Many of these belong to the past history of lithotrity, and occurred before lithotrity had attained its present state of perfection. At the present day we seldom hear of laceration of the urethra, perforation of the walls of the bladder, fracture of the instruments, &c. Other accidents, however, evidently depend on the operation, and may be fairly attributed to it. Thus, lithotrity always

produces more or less pain and uneasy sensations. These are sometimes slight; in more difficult cases it is impossible, unless we employ chloroform, to avoid inflicting a certain amount of pain. When the operation has been restricted within its proper limits, and due precautions are used, the pain is almost always of a nature to be readily borne by the patient. The contrary may occasionally happen. The bladder and urinary organs may be apparently healthy, the calculus small, every precaution has been used, yet the neck of the bladder is excessively irritable; the passage of an instrument will, in such cases, excite great pain, and if the operation be persevered in, dangerous constitutional disturbance may ensue. These are cases well suited for chloroform.

Many other cases are on record, in which the pain is described as having been of the most violent nature, and its effects of a disastrous kind; but on examining them, we shall generally find that one or more conditions were present, which rendered the application of the operation improper.

The same causes which produced pain, may likewise give rise to more or less discharge of blood from the urethra, or the bladder.

A patient operated on at the Hotel-Dieu, in 1832, died of hemorrhage from the bladder, and Mr. Key relates a case where the bleeding was so copious as to render necessary an immediate recourse to lithotomy. In one or two cases, I have been myself incommoded by the amount of blood lost, but I never met with a case of dangerous hemorrhage from lithotrity. Sir B. Brodie also informs us that in the 115 cases operated on

by him, he did not meet a single example of serious loss of blood from the urinary organs.

The surgeon who undertakes lithotrity, should never for an instant lose sight of the condition of the bladder after the first operation of crushing, for retention of urine may at any time supervene. The use of the instruments almost invariably determines an urgent desire to empty the bladder; but no sooner is the operation over, than the desire ceases in a great many cases, and may be replaced by retention of urine. The expulsive power of the bladder should therefore be carefully watched, and the causes of retention determined. It may depend on coagula, impaction of a fragment in the urethra, &c., but more frequently it arises from some loss of power in the bladder, combined with a spasmodic state of the urinary passages. This latter condition often exists in elderly persons affected with enlargement of the prostate. The hip-bath, followed by a full dose of opium, often removes this spasmodic condition, but it will be more prudent to draw off the urine with a catheter, as soon as any difficulty of emptying the bladder occurs.

In a few cases, the operation has given rise to suppression of urine, and the consequences attendant on that serious condition. It is probable that the operation, however, has merely called to light some latent disease of the kidney which previously existed.

Acute cystitis is of rare occurrence, but in hospital practice we hear of many cases of subacute or chronic cystitis, resulting from, or at all events, following lithotrity. The patient is then left in a very distressing

condition, and the results of lithotrity, if judged of from these cases, would appear anything but favorable. It is by no means easy to determine the circumstances under which the subacute inflammation now alluded to has been produced. In private practice we do not frequently meet with cases of the kind, and it is certain that catarrh of the bladder is more often relieved than aggravated by a properly conducted operation of lithotrity. As far as I can judge, it seems to me that in many of the unfortunate cases alluded to, the severe chronic inflammation, and other accidents have arisen from retention of imperfectly pulverized fragments in a diseased bladder.

The constitutional accidents of lithotrity may be comprised under rigors, febrile attacks, and nervous disturbance. Many patients experience a smart attack of rigor immediately after the operation, especially after the first sitting. It is not known on what the rigors depend; they have been attributed to sympathy and other indefinite states, which leave us as much in the dark as ever. They do not bear any proportion to the amount of pain, but experience teaches us that they are apt to be severe when the operations have been prolonged. A full dose opium, or a tumbler of brandy and warm water, as recommended by Sir B. Brodie, are the best remedies; their action will be assisted by placing the patient at once in bed, and covering him with a warm blanket.

The rigors may be followed by a temporary attack of fever which resembles the irritative fever of some authors; or a more severe and permanent attack may ensue, rapidly assuming a typhoid character, and ter-

minating in death. These latter cases, I am fully convinced, depend on phlebitis or purulent infection of the blood.

Another accident to which patients who have undergone lithotrity are liable, is the lodgment of calculous fragments in the canal of the urethra. Young patients are peculiarly liable to this complication, which often occurs in the adult likewise. If neglected, it may give rise to very severe symptoms. Inflammation and ulceration of the canal are produced, extravasation of urine follows, irritative fever sets in, and the result may be death.

The fragment may be stopped at any part of the urethra, but the most common seats are the neck of the bladder and the membranous portion of the urethra. The symptoms resulting from impaction of a fragment in the urethra are usually severe and well marked. A rough sharp fragment of any size soon excites pain about that part of the canal where it is arrested. The patient suddenly discovers that he is unable to pass water freely, or he may have complete retention; the desire to urinate soon becomes frequent and urgent. These symptoms should always arouse the surgeon's attention: if relief be not given, and that speedily, dangerous constitutional disturbance may ensue. The patient becomes irritable; his rest is disturbed; rigors often set in; these are followed by irritative fever of a severe kind; the irritation extends to the bladder, perhaps to the kidneys, and the patient may be cut off in a deplorable condition.

An accident of this kind requires prompt and effectual means for its relief. As soon as the surgeon

has any reason to suspect its existence he should pass a sound into the urethra to ascertain the seat and nature of the fragment. A large metallic sound may be used in the first instance; and if this fails to detect the foreign body, a large-sized soft bougie may be introduced, for it is possible that the fragment may be lodged in one of the lacunæ. If this be the case, the edge of the fragment, as M. Civiale observes, seldom fails to leave a mark on the bougie.

For the removal of the fragment various means have been proposed; thus it may be pushed back into the bladder, extracted whole, crushed in the urethra, or removed by external incision. The choice of a method will be governed by the circumstances of the case. Where the fragment is impacted in the neck of the bladder, or behind the triangular ligament, great difficulty will be experienced in extracting it, and the best practice will be to push back the foreign body into the cavity of the bladder. When the fragment is small, and seated close to the neck of the bladder, this can easily be done with the sound or bougie; a fragment more firmly impacted will, of course, present more resistance; in such case, some tepid water should be forcibly injected into the urethra, while pressure with the sound is exercised at the same time.

Impaction often takes place in the membranous portion of the urethra, and in this situation the fragment may be extracted whole or crushed. I must confess that the expediency of crushing fragments seated so far back in the urethra seems to me very doubtful. For extraction, various kinds of forceps are employed; or a blunt hook may, perhaps, be passed behind the

fragment; and the same means may be had recourse to whenever the fragment is seated at any point between the bulb and the glans penis. Should these means fail, nothing remains but to cut down on the foreign body through the urethra, and extract it. Here, however, an important matter must not be overlooked. Great caution is required in all cases where the fragment may be seated in that part of the spongy portion of the canal which corresponds to the scrotum. Division of that part of the urethra which is covered by the scrotum is liable to be followed by infiltration of urine and urinary abscess. The danger of this occurrence was long since pointed out by Deschamps, and in later times has been dwelt on by Sir B. Brodie and Mr. Liston.

The various points connected with the indications and contra-indications of lithotrity require to be considered with the utmost care; for the success of lithotrity, more perhaps than any other operation, mainly depends on its being applied in a proper manner; that is to say, on a strict observance of the indications established by experience.

When lithotrity is confined to those cases which are suited to it, and when the cases are of a simple nature, no other important operation is performed with less difficulty, and no other is attended with such brilliant results. This conclusion we are now entitled to draw from facts on which no suspicion rests. Mr. Charles Hawkins assisted at sixty operations performed by Sir B. Brodie, all of which terminated successfully. On the other hand, we know that lithotrity becomes extremely difficult in its performance, and is often at-

tended with fatal results if it be applied to cases which are not suitable for the operation. Of the first twelve patients operated on by M. Velpeau, three died, five were cured; and in four cases the operation was abandoned, the surgeon being unable to terminate it. There must be some reason for such extraordinary differences between results. I would attribute it principally to the care taken by some operators not to violate the rules of science by employing an operation in cases where it should not be had recourse to.

In order to discover the indications and contra-indications of lithotrity, we must bear in mind the various steps which, taken together, constitute the operation. Reflecting on these, we shall find that certain conditions are requisite, before this operation can be performed in a safe and proper manner, or we can obtain from it the results which it is capable of yielding.

Thus, we must be able to introduce our instruments into the bladder; having introduced them, we must be able to seize and fix the calculus; having fixed the stone, we must be able to crush it into small fragments; these latter must have a ready exit from the bladder; and, finally, the various steps of the operation must be performed without exciting any serious disorder in the urinary organs, without aggravating in a dangerous way any disorder which may already exist, and without inflicting any serious injury on the general health of the patient. To perform lithotrity in a successful manner, the different conditions just enumerated must be strictly fulfilled, and we have, therefore, only to ascertain what circumstances prevent the fulfilment of these conditions, in order to discover the contra-indications of lithotrity.

Experience has abundantly established the circumstances most favorable for the performance of lithotrity. Whenever the calculus is small, the bladder healthy, the urinary organs free from irritation, and the general health not deteriorated, the patient presents the most favorable conditions; and nearly all surgeons are now agreed that lithotrity is unquestionably indicated. But such cases are not very frequent. Patients are seldom willing to undergo what they consider a dangerous operation, until the urinary organs, and, subsequently, the general health, have more or less suffered. According to the nature and degree of these sufferings will the operation be indicated; and it is therefore necessary to point out the conditions which render it unsuitable in any given case.

Serious obstacles to the introduction and mechanical action of the instruments may be regarded as contra-indications, or the latter may be of a more general nature. The contra-indications arising from any mechanical obstacle to the introduction of the lithotrite have been already noticed; we must suppose that the urethra is sufficiently free to admit the passage of the instruments into the bladder.

Omitting these, the nature and mode of operation of which are sufficiently obvious, it may be stated that the principal points on which the applicability of lithotrity, in any given case, depends are, first, the nature of the calculus; the condition of the urinary organs; and, third, the health of the patient, together with some circumstances of a general nature, as age, sex, &c.

As regards the calculus itself, the choice of the operation to be selected will be influenced by

the number of calculi, their size, form, position, and density.

A single calculus is more suited to lithotrity than several calculi; this holds good with respect to lithotomy also; but the mere number of foreign bodies taken in the abstract, is not a bar to the performance of the operation. M. Civiale has operated with success in a case where the bladder contained 40 calculi. What we are to be guided by is the time which may be required for crushing and getting rid of them; and hence the number of calculi is no great obstacle provided they be at the same time small and soft.

The size of the calculus is an important element to be taken into account in any operation employed for its removal. A large stone always creates more or less difficulty, and the question will arise how far it can be crushed with safety to the patient. To determine this question, we must look chiefly to the nature of the calculus, and the condition of the bladder. When the stone is large, and, at the same time, dense, I think that lithotrity is contra-indicated; if the foreign body be friable, as phosphatic deposits usually are, and if the bladder be not strongly contracted over the calculus, lithotrity is not contra-indicated. The larger the stone, the greater is the necessity that the bladder should be tolerably healthy; yet these two conditions do not often coexist.

It may be a question how far, with our improved instruments, mere density of the calculus may ever prove so great an obstacle as to constitute a contra-indication. Mulberry calculi are, however, sometimes exceedingly hard; they cannot be reduced into fragments without a

considerable number of operations; and the possible consequences of such repeated manipulations in the bladder, would lead me to incline to the side of lithotomy.

The position of the calculus may be unfavorable to the operation of crushing. It may depend on various morbid conditions of the bladder, which I have fully described in my work on 'Lithotrity and Lithotomy.' Thus, a small calculus may become entangled between the meshes of a columnar bladder, and elude all our efforts to seize it: the foreign body may be enclosed in a cyst, either wholly or partially; it may be hooked up above the pubes; attached to the surface of the bladder by fibrous tissue; or finally embraced in a separate compartment, which seems to be produced by irregular action of the muscular fibres, analogous to the hour-glass contraction of the uterus. In the greater part of these cases, lithotrity is contra-indicated, for the simple reason that the stone must be caught before it can be crushed; yet, as the cutting operation is almost equally inapplicable, some attempt may be made to dislodge the stone from its abnormal position. Should this be effected, the difficulty is removed, else I would not venture on lithotrity.

The condition of the urinary organs is the next point to be considered in reference to the indications of lithotrity. Health and disease take, of course, opposite sides in the scale; but it is a delicate matter to determine, in all cases, what morbid conditions of the genito-urinary organs are incompatible with the safe and successful application of lithotrity. We have to avoid rashness on the one side; and, on the other,

restricting within too narrow bounds the useful sphere of the operation.

The state of the prostate first demands attention; it may influence the operation and its results, as well as the simple introduction of the instruments. Enlargement of the prostate, unless it be considerable, may be overcome as a mechanical obstacle; but it produces many other unfavorable effects.

Enlargement of the middle lobe, especially, diminishes the capacity of the bladder, deepens its floor, and tends to conceal the stone in a cavity behind the enlarged gland. These circumstances impede the action of the instrument in seizing and crushing the foreign body; they also impede the ready discharge of the fragments—an objection of great importance, when we consider how often enlargement of the prostate is attended by an irritable or diseased state of the urinary reservoir. Enlargement of the prostate is, therefore, an unfavorable circumstance in all cases; but not an absolute contra-indication. The precise nature and extent of the obstacles it may create must be determined by careful examination; and then we proceed to consider how far this unfavorable element may influence other conditions.

Thus, when the enlargement is moderate, the operation is not forbidden, provided the stone be small and the urinary organs not very sensitive. On the other hand, when the enlargement is considerable, we should not have recourse to lithotrity, if there be any reason to suppose, from the size and hardness of the stone, &c., that the operation will require a number of sittings.

Any serious disorder of the urinary organs, co-existing

with enlargement of the prostate, should, in my opinion, also be regarded as contra-indications.

Chronic inflammation or catarrh of the bladder is of very frequent occurrence in calculous patients, and it is therefore of importance to examine how far such a condition may influence our choice of the operation to be selected. Simple calculous catarrh of the bladder, instead of being aggravated by lithotrity, is almost always alleviated by comminution of the foreign body. It gives me satisfaction to state that this opinion, on which I have insisted in another work, has been fully confirmed by the experience of Sir B. Brodie.

In a paper read before the Medical and Chirurgical Society, on the 13th of March, 1855, Sir B. Brodie expresses his opinion "that inflammation of the mucous membrane of the bladder, induced by calculus, and indicated by great irritability of the organ and the copious secretion of mucus, does not form an absolute objection to the operation, although it is doubtless a reason for proceeding with more caution, for, on the contrary, it often happens, under such circumstances, that the crushing of the calculus is followed by an alleviation of all the bad symptoms."

According to my own experience it is only where the chronic inflammation of the bladder has been of long standing, or is complicated with other lesions, that it becomes necessary to reflect whether the state of the vesical mucous membrane will admit of our employing instruments without danger. If the catarrh were accompanied by any organic or severe affection of the neck or body of the bladder, I should certainly abstain from lithotrity.

Purulent catarrh of the bladder I also hold to be a positive contra-indication. In this I know that I differ from a high authority; but experience has taught me that a purulent secretion from any part of the genito-urinary system, may, under the influence of an operation, become a determining cause of purulent infection of the blood.

Another condition of the bladder, which contra-indicates lithotrity, is hypertropy, with diminution of the cavity and extreme irritability. It is unnecessary to point out how dangerous any manipulations would be in an organ thus affected.

Small fibrous tumours about the neck of the bladder may impede the operation without absolutely contra-indicating it; but vascular or cancerous tumours in the body of the bladder should, in my judgment, be regarded as positive contra-indications.

As the expulsion of the detritus must be chiefly effected by the bladder, paralysis of that organ has been mentioned by nearly all writers as a condition which renders lithotrity inapplicable. This observation does not accord with my own experience. These cases require great care; the sittings must be short, and the bladder must be injected from day to day with the large catheter figured in page 468, to promote the discharge of the detritus. I repeat that these cases require great care, as they are frequently connected with disease of the kidney and spinal cord. A case of this kind has occurred to me in the last two years. A gentleman, æt. 64, with complete paralysis of the bladder, had a large calculus and an affection of the spine and kidney; the former indicated by diminution of

power of the lower extremities; and the latter, by occasional severe pains in the lumbar regions, and down the thigh, with swelling of the testicles. The calculus had not produced much distress about the bladder, but fearing the consequences, it was thought desirable to get rid of it. So much care, however, was required in this case, that the sittings have been extended over a period of two years. If the object of medical science be the prolongation of life under all conditions, the delay in this case was the only means to secure the object. During the whole of this time the patient was watched by Dr. Oldham, and Mr. Barnett of Blackheath, to whose unremitting care the patient is indebted for the preservation of his life. Last year, a patient of Mr. Cathrow's, of Weymouth-street, was operated on by me for stone. He had complete paralysis of the bladder, but no disease of the spine and kidneys. The stone was crushed without difficulty, and the detritus removed by washing out the bladder in the way which I have described. He was quite cured, and is well at the present time.

The bladder is sometimes partially paralysed, a condition which also requires care. In these cases the catheter must be regularly used, and the bladder washed out daily, as in those cases in which the organ has entirely lost its power.

Much more frequently, however, it happens that the bladder of calculous patients is in a condition directly opposite to the one just noticed. The constant irritation kept up by the foreign body produces increased sensibility of the urinary passages and bladder. In some cases the highly sensitive state of the urinary apparatus

depends on nervous influence, and may be controlled by proper treatment; but lithotrity is contra-indicated whenever the increased sensibility depends on organic disease, or is connected with increased contractility and hypertrophy of the bladder. Disappointment and failure will often result if we attempt to crush the stone in cases of this kind, and the most prudent course will be to abstain.

Certain conditions of the general health contra-indicate lithotrity. When patients have suffered from a calculous affection for many years the general health is often greatly deteriorated, although no signs of any organic disease may be discoverable in the bladder or kidneys. The patient is much reduced in flesh and strength; he is nervous; the digestive organs are deranged; attacks of fever occur every now and then; the bladder is contracted, and the desire to pass water is frequent. Lithotomy holds out greater chance of relief in these unpromising cases.

Disease of the kidney often accompanies calculus; the affection is sometimes manifest; often it is latent; or disease may be developed under the influence of an operation. What indications are to be drawn from the existence of renal disease in a person labouring under stone? and what from the possibility of its being lighted up by an operation in persons predisposed to such malady? Should lithotomy be preferred to lithotrity in cases of this kind? These are practical questions extremely difficult to answer. M. Civiale thinks that lithotrity has less tendency to exasperate any existing lesions of the kidney; yet when we reflect on the nature of the two operations we find it difficult to

understand how this can be the case. If we select lithotrity, it should, in my opinion, be when the renal disease is not far advanced, and when the condition of the bladder and nature of the calculus lead us to conclude that the operation may be completed within a short period.

The indications derived from age may finally be noticed. In former editions of this work I stated my opinion that all cases of calculus in children under twelve or fifteen years of age should be treated by lithotomy. The following are the chief objections against the propriety of applying lithotrity to the young subject. The genito-urinary organs are not fully developed before the age of puberty. The diameter of the urethra is small; the antero-posterior diameter of the bladder is short; the bladder of children is irritable, and the neck of this organ is very dilatable, a circumstance which favours impaction of the fragments; lastly, the indocility of the child is a great obstacle.

On the other hand, it is well known that lithotomy is highly successful in children, not more than one in fifteen or twenty dying after the operation when performed on subjects under fourteen years of age.

Many of these reasons have only a certain degree of force, and do not, I am now free to confess, constitute insurmountable objections. If the organs be small, our instrument makers now construct small lithotrites of sufficient force. The irritability of the bladder in children does not arise from a state of disease. Indocility may be overcome by the use of chloroform. Lithotomy is, undoubtedly, most successful in children; but the success is in a great measure connected with the healthy

condition of the urinary organs in the young subject; and hence it may be fairly argued that if lithotrity diminishes the mortality in adults, it should have a still greater influence in reducing the comparative mortality when applied to children, because the number of deaths in adults, after crushing the stone, is greatly increased by the state of the urinary organs at that period of life. Within the last few years lithotrity has been applied to children in the London hospitals, by Mr. Fergusson, Mr. Curling, and others; and the general results have not been unfavorable. The youngest patient was a female child $2\frac{1}{2}$ years old, on whom Mr. Poland, of Guy's Hospital operated with success. In this case, however, it was necessary to divide the urethra.

The statistics of lithotrity will be noticed with those of lithotomy.

CHAPTER XXI.

LITHOTOMY.

There are three different parts at which the bladder may be opened for the purpose of extracting calculi.

I. At the anterior and superior surface above the pubes, by what is called the high operation.

II. At the inferior and posterior part, through the rectum, by the recto-vesical operation.

III. Near the neck through the prostate, by the perineal section and lateral operation.

The High Operation.—In order to perform this operation, the bladder must rise above the superior edge of the pubes, which, when empty, it does not reach. Hence, it is necessary either to distend the bladder by injection; to wait until sufficient urine has accumulated to produce the desired effect; or to elevate the anterior and superior part of the viscus by means of a sound, the point of which is made to glide from below upwards, against the posterior surface of the pubes. It is obvious, therefore, that the operation is impracticable in all cases where the bladder does not readily admit of distension. Should

the presence of the stone have produced much irritability of the parietes, a sufficient quantity of fluid cannot be injected into its cavity.

This method of operating is now nearly abandoned in this country, though it is still practised occasionally in France; and, judging from its results in the hands of M. Souberbielle, with a very fair amount of success, in the worst description of cases, viz., those in which the stone is of large size.

Mr. Carpue having witnessed many of M. Souberbielle's cases, endeavoured to reintroduce this operation into England.

Professor Gibson, of Philadelphia, performed it in the case of an old gentleman who was affected with great enlargement of the prostate, but the patient died soon afterwards from peritonitis, consequent upon urinary effusion. Dr. Carpenter, of Lancaster, Pennsylvania, repeated the operation soon after, with a more fortunate result. Dr. George M'Lellan, of Philadelphia, performed the operation several times; but the results did not encourage others to follow his example. It would seem to be an easy and a simple operation; but such is not the case, and the objections which induced Cheselden, Douglas, and others, to relinquish it, are based upon good grounds. It is true there is no danger of hemorrhage; that neither the rectum, nor the seminal ducts, can be wounded; but then the bladder cannot always be fully distended, and there is great risk that the peritoneum may be injured. Such an accident is immediately followed by the protrusion of some folds of intestine, and probably by acute peritonitis; or the bladder being

opened, and the peritoneum being wounded, urine may escape into this cavity, and produce fatal results.

The force sometimes necessary to distend the bladder to a sufficient extent for the high operation, may be illustrated by two fatal cases of Cheselden's, in which the bladder was burst from injecting too much water.

When there is a great accumulation of fat in the supra-pubic region, the external incisions must be both long and deep; and the bladder, when opened, lying at a distance from the surface, cannot satisfactorily be explored; neither, under these circumstances, would it be a fit proceeding for the extraction of an encysted calculus.

The operation is most easily performed on young subjects, in whom the pelvis is small, and the bladder still to be enumerated among the abdominal viscera. But these are the very patients upon whom the lateral operation may be performed with the greatest prospect of success. A patient may be labouring under such extensive disease of the bladder and kidney as to almost render any operation improper; but it has never occurred to me to meet with a case in which a better chance of recovery would occur from opening the organ above the pubes. Even in the case of a large stone, when fears may justly be entertained that there may be insufficient space for its extraction entire under the arch of the pubes and through the perinæum, I do not consider the high operation advisable; for the bladder in almost every instance of the kind is thickened, contracted, and incapable of distension behind the pubes, and no instru-

ment can be introduced through the urethra to assist in elevating its anterior wall to the line of incision.

This operation, however, being decided upon, the patient should be placed in the recumbent posture, with the shoulders slightly elevated, and the feet resting on a chair. The parts having been shaved, and the boundary of the distended bladder being clearly ascertained, the surgeon should make an incision from three to four inches in length along the mesial line, commencing about half an inch above the symphysis pubis. The aponeurosis of the obliquus externus abdominis having been exposed, a small opening is made into the supra-pubic space, which is filled with fatty cellular tissue, and bounded above by the reflexion of the peritoneum from the urachus to the posterior surface of the abdominal walls. A grooved director having been introduced, the linea alba is divided to the requisite extent. Hæmorrhage having been arrested, the bladder is sought for; it feels like a soft fluctuating tumour at the bottom of this deep wound. The organ may be secured by a hook, or tenaculum given to an assistant, to prevent it, when opened, collapsing beyond the reach of the operator. A small opening having been made into its lower and front part, the knife is introduced, with its edge directed upwards. The instrument is then cautiously carried upwards for about two inches, its course being guided by the fore and middle fingers of the left hand introduced into the vesical cavity. It is safer for this last part of the proceeding to use a knife with a rounded or a probe-pointed extremity. The forceps is now introduced, and the calculus extracted. A gum-elastic catheter, or a silver tube should

be left in the wound, for the purpose of preventing infiltration of urine into the cellular tissue of the pelvis and of the lower part of the abdomen.

In a case operated upon by Pye, fatal hæmorrhage ensued. "In the old method of performing this operation," says Carpue, "hæmorrhage must be common, as I have been sent for to examine three persons who died shortly after the operation, and in whom, on inspection, I found the cause of death to be hæmorrhage from the puncture of a branch of the circumflexus ilii, which anastomosed with the epigastric."

The high operation should, in my opinion, be reserved for those cases, extremely few in number, in which the pelvis is so deformed that the proper incisions cannot well be made in the perinæal space. "I once saw," observes Mr. Bransby Cooper, "the high operation performed by Sir Everard Home, and a most difficult operation it was: after he had cut down through the parietes of the abdomen, he was obliged to make an opening in the perinæum, and pass an instrument into the bladder from below, to enable him to open the bladder above the pubes. After much difficulty, a calculus was removed, but the patient died, in consequence of this complicated operation, a few hours after its completion. A friend of mine," Mr. Cooper adds, "some years since was present at the performance of the high operation of lithotomy, by M. Civiale. In making the first incision through the parietes of the abdomen, he wounded the peritoneum which led to the protrusion of the small intestines. He returned these into the abdomen and continued the operation, and ultimately succeeded in extracting a stone. The patient was put

to bed, and M. Civiale, on subsequent consideration, dreading the liability of extravasation of urine into the peritoneum, determined on laying open the bladder from the perinæum. He effected this, and so completely succeeded in preventing the result he feared, that the patient ultimately recovered." Mr. Humphrey, surgeon to Addenbrooke Hospital, Cambridge, has published a successful case of the high operation, and given the results from the practice of various surgeons, which show the mortality to be 1 in 3·08.

The Recto-Vesical Operation, claimed by Sanson as his own, has been recommended on the ground of being free from the danger of hæmorrhage, and of affording a ready passage to the instruments necessary to seize and extract the stone. Sanson divided the sphincter ani and the lower part of the rectum by a vertical incision corresponding to the raphe of the perinæum. Continuing the dissection, he exposed the bulb and membranous portion of the urethra, the prostate, and lower wall of the bladder. The prostate may then be divided upon a staff introduced into the bladder through the urethra, or the knife may be passed behind the prostate, through the wall of the bladder, into the groove of the staff, and the base of the bladder divided.

The objections to this operation are great. When the cavities of the rectum and bladder have been thrown into one, it is by no means certain that the communication will close. I have myself witnessed cases in which a recto-vesical fistula has remained for years, the result of an incised wound. The division of the prostate

exposes the vasa deferentia to danger, and the wound of the neck of the bladder may be complicated with a wound of the vesiculæ seminales, producing atrophy of the testicles. The recovery from such an operation must necessarily be tedious, and the whole proceeding is even more objectionable than the operation above the pubes.

But it has already been discarded; and cannot be recommended even in those cases where the calculus is impacted in the walls of the bladder. Although the danger of hæmorrhage is stated to be inconsiderable, arteries of some size may be wounded by so deep an incision. In 185 cases of this operation the mortality was 38, or 1 in 4·86.

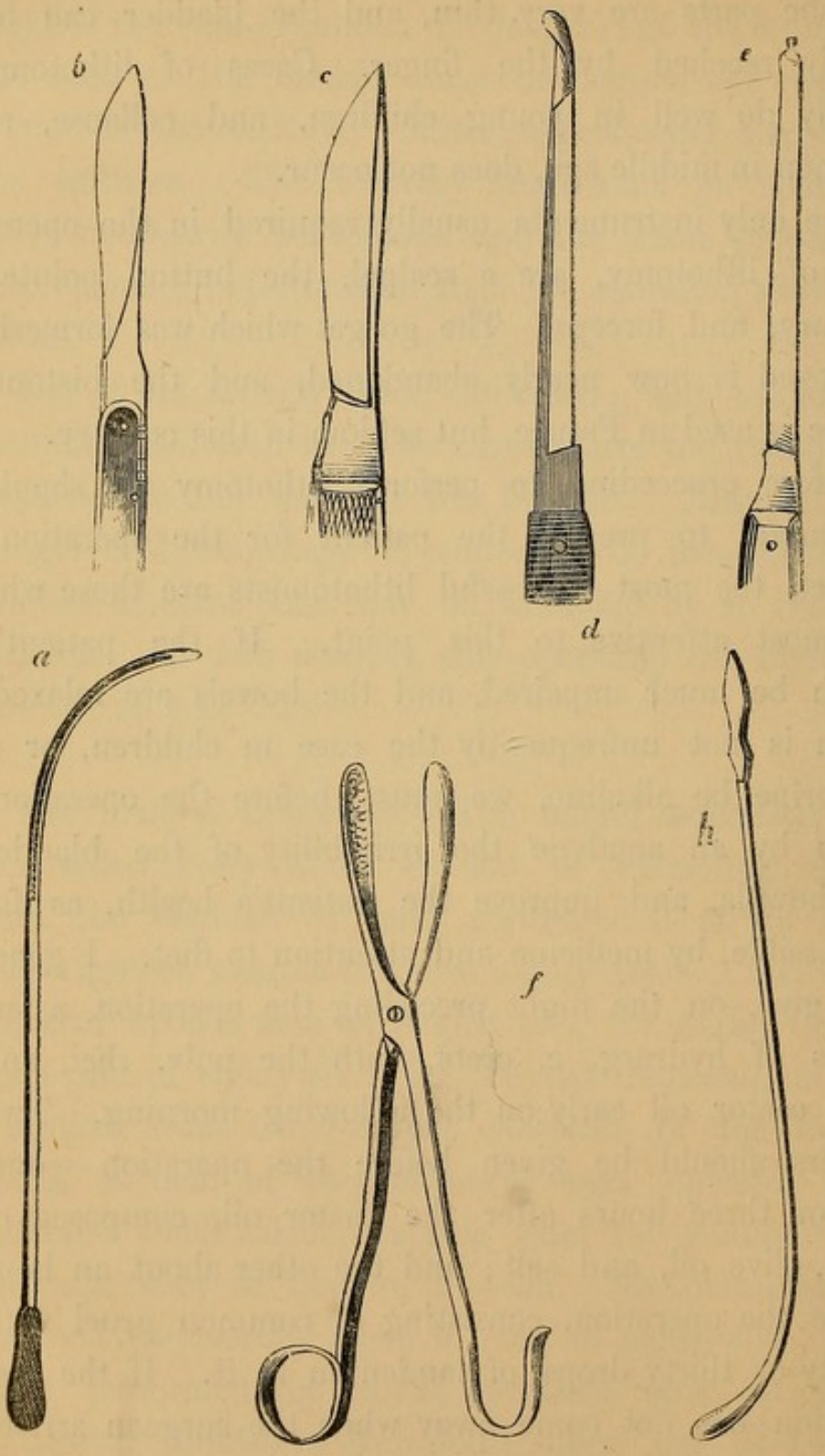
The Lateral Operation.—The lateral operation has superseded every other method of extracting calculi from the bladder. I have performed it at all ages, from eighteen months to above eighty years. Mr. Cline operated upon a man of eighty-two, Sir Astley Cooper upon one of eighty-six. Dr. Physick removed, at one operation, from Chief-Justice Marshall, of the United States, a man of very advanced age, upwards of a thousand small calculi, varying from the volume of a partridge shot to that of a bean. Mr. Attenburrow operated successfully upon a man of eighty-five. Mr. Keate performed the lateral operation upon an infant of twelve months; Mr. South upon one of twenty months. Civiale refers to a child that was cut at ten weeks.

In very young subjects the bladder is somewhat of an abdominal viscus; but the perinæum is devoid of

fat, the parts are very thin, and the bladder can be readily reached by the finger. Cases of lithotomy usually do well in young children, and collapse, so common in middle age, does not occur.

The only instruments usually required in the operation of lithotomy, are a scalpel, the button pointed bistoury, and forceps. The gorget which was formerly employed is now nearly abandoned, and the bistouri cachée is used in France, but seldom in this country.

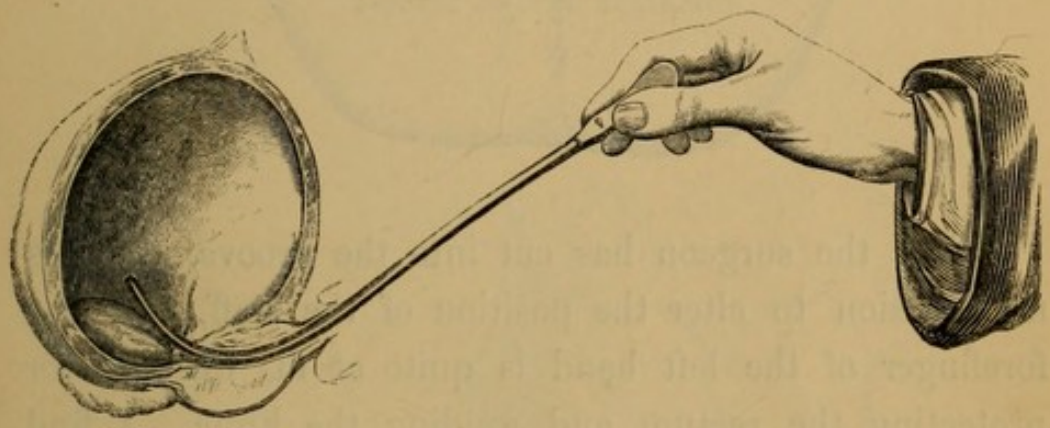
Before proceeding to perform lithotomy we should be careful to prepare the patient for the operation; in fact, the most successful lithotomists are those who are most attentive to this point. If the patient's health be much impaired, and the bowels are relaxed, which is not unfrequently the case in children, or if the urine be alkaline, we must, before the operation, lessen by an anodyne the irritability of the bladder and bowels, and improve the patient's health, as far as possible, by medicine and attention to diet. I generally give, on the night preceding the operation, a few grains of hydrarg. c. creta, with the pulv. rhei, and some castor oil early on the following morning. Two clysters should be given before the operation — one, two or three hours after the castor oil, composed of gruel, olive oil, and salt; and the other about an hour before the operation, consisting of common gruel with twenty or thirty drops of laudanum in it. If the last injection has not come away when the surgeon arrives to perform the operation, he should urge the patient, if an adult, to go to stool; if a child, it will generally happen that the injection, if it has not passed off, will do so when the staff is introduced. On no account



MODERN INSTRUMENTS. *a.* STAFF. *b.* LISTON'S KNIFE. *c.* COULSON'S KNIFE. *d.* BLIZARD'S KNIFE. *e.* COULSON'S STRAIGHT BUTTON-POINTED BISTOURY. *f.* FORCEPS. *h.* SEARCHER.

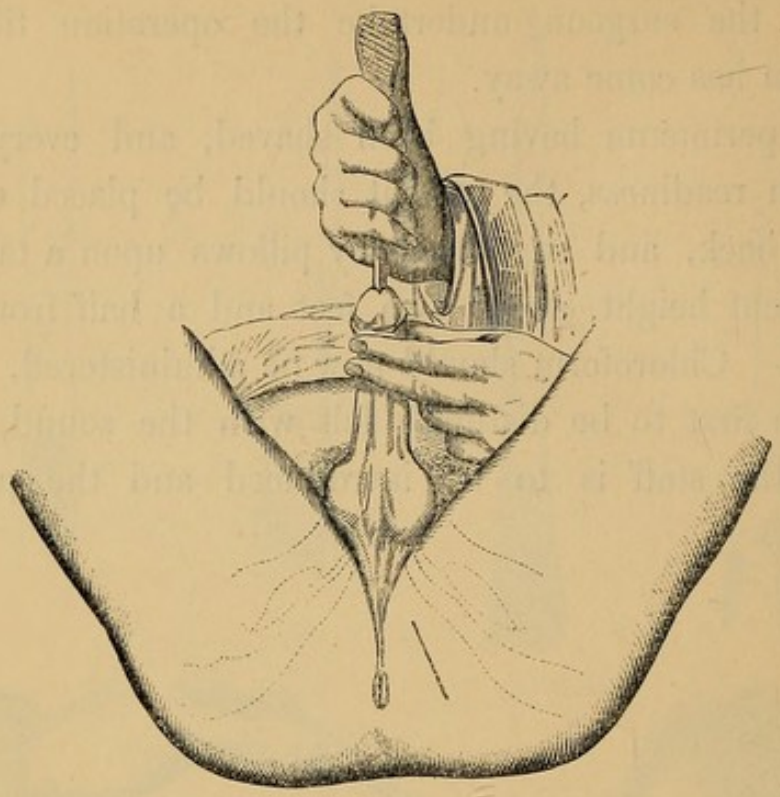
should the surgeon undertake the operation till the injection has come away.

The perinæum having been shaved, and everything being in readiness, the patient should be placed evenly on his back, and supported by pillows upon a table of convenient height, about two feet and a half from the ground. Chloroform should now be administered. The stone is first to be distinctly felt with the sound, after which the staff is to be introduced and the patient bound.



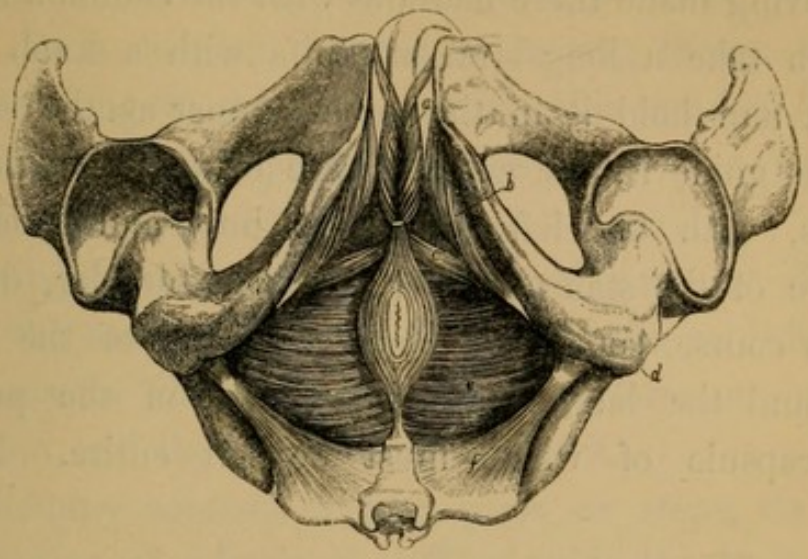
BLADDER SHOWING THE CALCULUS STRUCK WITH THE SOUND.

The staff should possess a curve of sufficient length to enable the point to enter fairly into the bladder; and the groove should be deep, situated either in front or a little to the side, and cease about a quarter of an inch from the extremity of the instrument. I give the staff to the care of an assistant, directing that the handle, which should be broad and rough, so as to be easily and firmly grasped, be held quite perpendicular and immovable from the first.

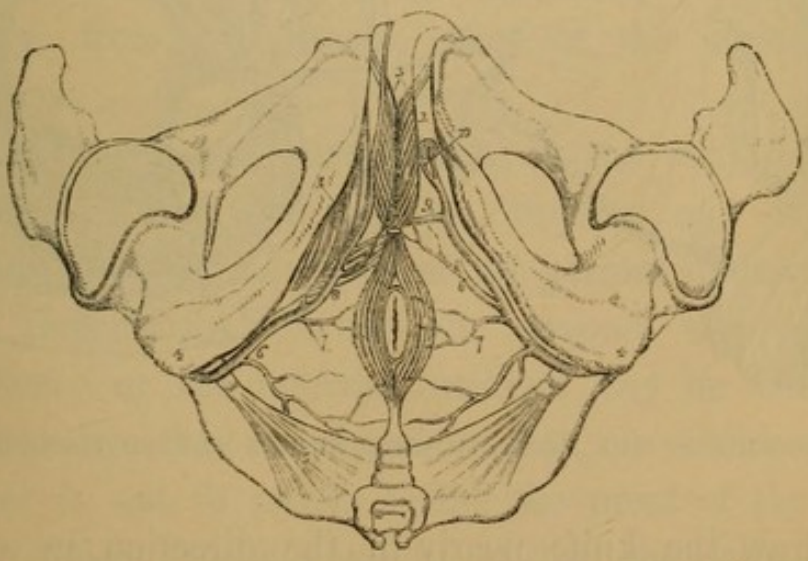


When the surgeon has cut into the groove, there is no occasion to alter the position of the staff, and the forefinger of the left hand is quite at his disposal for protecting the rectum and guiding the knife. I find that I can perform the operation more rapidly and safely in this way than by taking the staff into my own hand. If the groove be directly in front of the instrument, it must be slightly turned towards the left side.

Sitting upon a low chair I commence the first incision on the left side of the raphe, about two fingers' breadth above the anus, and terminate midway between this opening and the tuber ischii. I hold the knife somewhat like a pen, between the thumb and two next fingers of the right hand, and with two or three incisions I divide the skin, fat, and cellular layer comprised between the left erector penis and accelerator



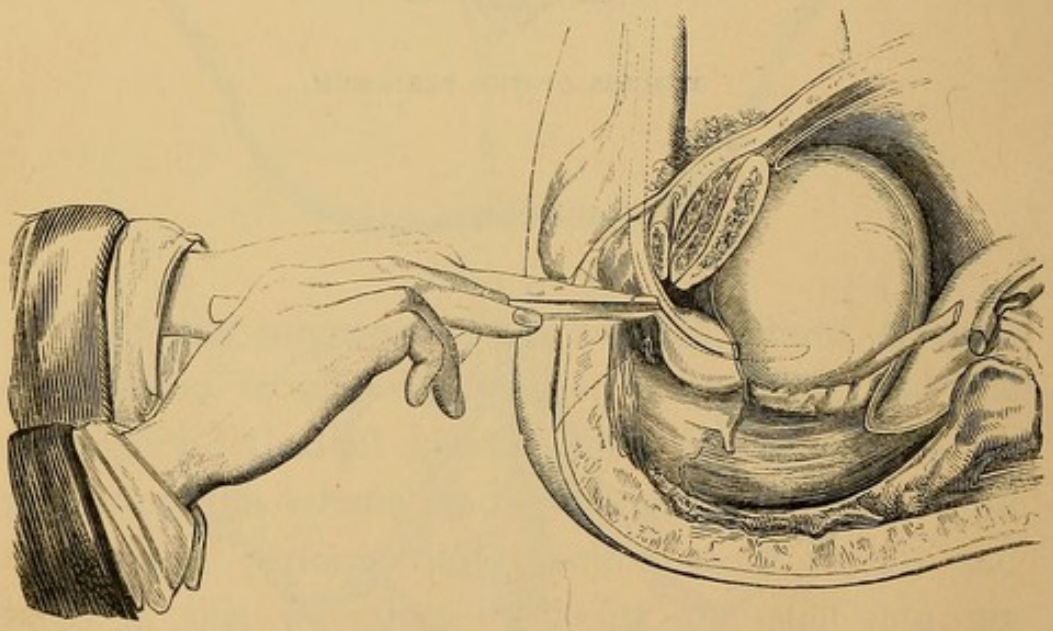
MUSCLES OF THE PERINÆUM.



VESSELS OF THE PERINÆUM.

urinæ, together with the fibres of the transversus perinei muscle. With the forefinger of the left hand I follow the scalpel till I feel the staff, and then open the membranous portion of the urethra so that I can introduce the nail of my left forefinger into the groove of the instrument.

Having made these incisions with the common scalpel, I then take a long straight knife with a knob at its point, and hold it in the same manner as the scalpel; I then guide it, the cutting edge being directed downwards, with my left forefinger, into and along the groove of the staff until it reaches the bladder, dividing in its course, some of the anterior fibres of the levator ani, and the lateral and lower part of the prostate, the capsule of which must be left entire. I then



SECTION OF THE PROSTATE WITH BUTTON-POINTED BISTOURY.

withdraw the knife nearly in the direction in which I introduced it, and insert my left forefinger into the bladder. Being satisfied that the opening into the bladder is sufficiently large, I direct the staff to be withdrawn, and introduce a pair of broad-bladed forceps along the left forefinger. The stone is then seized and extracted. It is scarcely possible to say too much as to the caution necessary in the extraction of a large stone. We are to withdraw it gradually from the

bladder, endeavouring to dilate the parts through which it is to pass, instead of tearing them; and it is astonishing to what an extent this gradual dilatation may be accomplished in the hands of a prudent surgeon.

Having thus described the lateral operation, I may follow the method adopted in the chapter on lithotrity, and consider the obstacles to the performance of the operation, and the accidents attending it.

Lithotomy consists of four parts or steps, viz., the introduction of a grooved staff to guide the knife; the external incision, the internal incisions, and finally the extraction of the stone. Anything which impedes the performance of these successive steps becomes an obstacle, from which arise most of the accidents of lithotomy.

Obstacles to the introduction of the staff and first incision are few, and do not require any extended notice. An unusual depth of the perinæum may cause some impediment during the second step of the operation; or the internal incisions may be somewhat impeded by the circumstance that, in children, the bladder is apt to recede before the point of the knife. Some difficulty may exist in making the point of the knife, unless a button-headed bistoury be used, to glide regularly and easily along the groove of the staff into the bladder. In more than one case the knife has slipped out of the groove. Accidents of this kind, however, seldom occur at the present day. We usually get into the bladder with ease, the great difficulty in many cases is to extract the stone. Numerous obstacles

may oppose this step of the operation; they are chiefly connected with certain conditions of the parts, or with the nature, position, and size of the calculus.

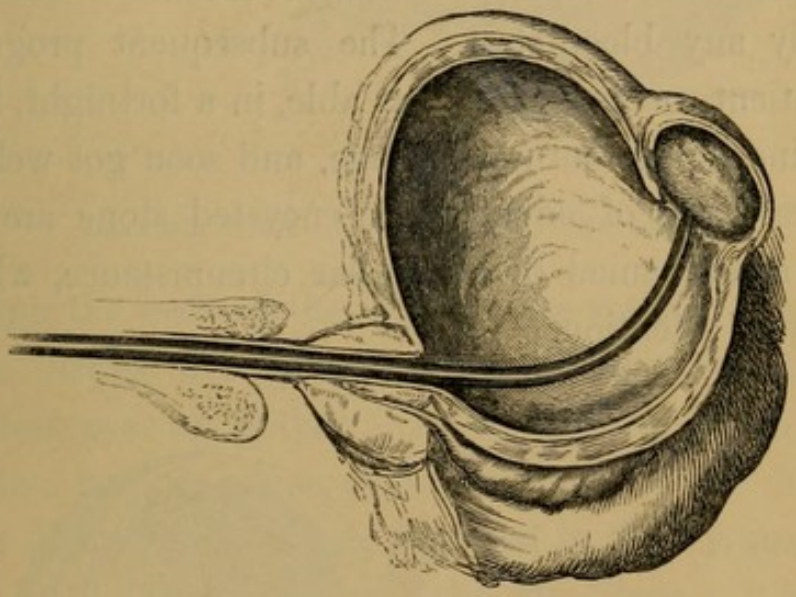
The foreign body is extracted with a particular kind of forceps, which is passed through the incisions into the bladder, expanded, closed over the stone, and then withdrawn in the direction of the external wound. During each of these steps the operator may encounter unexpected obstacles.

Enlargement of the prostate presents a greater or less obstacle to the easy performance of lithotomy. If indurated at the same time, it will impede the action of the cutting instrument; but the greatest obstacle it presents is to seizing the stone. It places the calculus beyond the reach of the finger, and increases the distance of the vesical cavity from the external surface of the wound; besides this, the enlarged gland, rising above the floor of the bladder leaves a cavity behind it in which the calculus lodges, and may easily escape the forceps.

Several morbid conditions of the bladder may impede the surgeon in his attempts to seize the stone. Most of these have been already noticed in the chapter on lithotrity.

Calculi, when encysted, adherent to the walls of the bladder, embraced in an abnormal contraction, or placed in an unfavorable position, will prove a source of embarrassment to the lithotomist as well as the lithotritist. Every surgeon who has operated frequently for stone, must have met with cases illustrating these facts. Some time ago, a case of this kind occurred to

me at St. Mary's Hospital. The patient, Robert Long, aged 11, had suffered since birth from incontinence of urine, a symptom which became more distressing during the six months preceding his admission. The child manifested no signs of pain; but there was a small quantity of blood and mucus mingled with the urine; with frequency of micturition; with occasionally the water suddenly stopped.

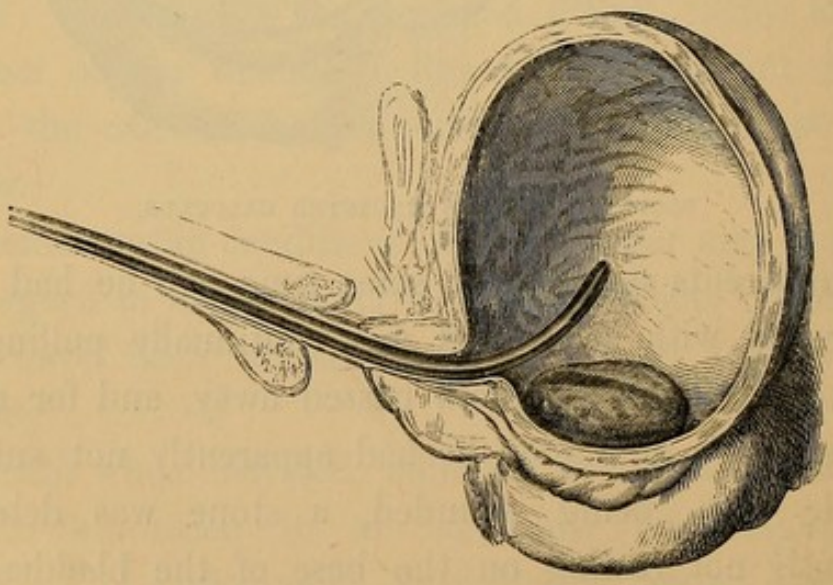


BLADDER WITH AN ENCYSTED CALCULUS.

The parents stated, that some time ago he had been tormented with pain, and was continually pulling the prepuce; but this symptom passed away, and for a few weeks before admission he had apparently not suffered at all. On being sounded, a stone was detected, evidently not resting on the base of the bladder, but lodged in the fundus, closely adjacent to the anterior wall, for it was only when the handle of the sound was depressed, and its point brought forward, that the stone could be struck.

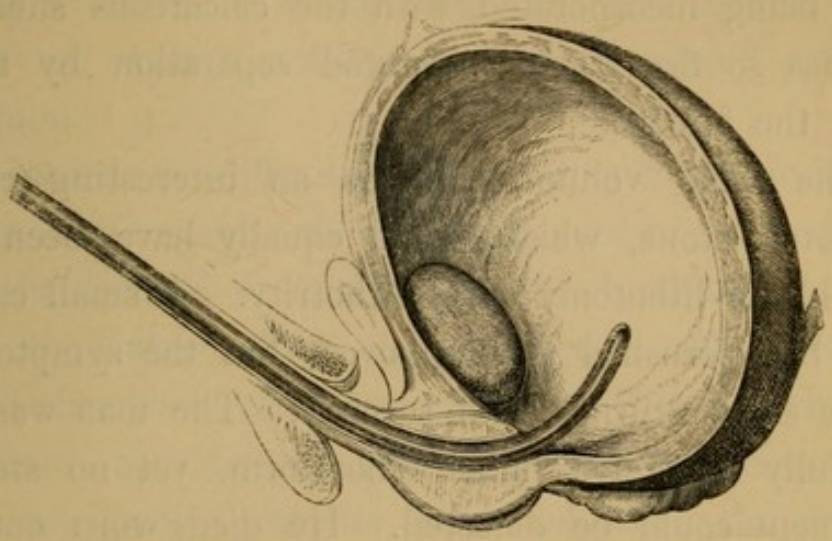
The bladder was penetrated by a beaked knife, but when I introduced my finger the stone could not immediately be felt, being situated quite anteriorly, and, in all probability, adherent to the front wall of the bladder; some difficulty would have been experienced in extracting the calculus, if the pelvis of the child had not been raised before the introduction of the forceps. By adopting this measure the stone was readily seized, and the operation completed within a minute. There was scarcely any blood lost. The subsequent progress of the patient was good; he was able, in a fortnight, to void his urine by the natural passage, and soon got well.

These cases of adherent or encysted stone are sometimes accompanied by a peculiar circumstance, which is worthy of attention.



CALCULUS BEHIND PROSTATE.

From the calculus being fixed in a particular spot, and probably from its being thus prevented from



BLADDER WITH CALCULUS ABOVE THE PUBES.

irritating the neck of the bladder, the rational symptoms of the disease are sometimes greatly modified, or may even disappear altogether. The manner in which calculi may thus become adherent to the walls of the bladder, is well illustrated by a case reported in the 'Transactions of the Pathological Society,'* by Mr. Shaw. "Midway between the orifices of the ureters, there was an oval spot, of the size of a sixpence, where the mucous and muscular coats were absent, and a quarter of an inch above the orifice of the left ureter there was a rough patch on the surface, somewhat smaller. A calculus had been adherent to each of these points. On one side of the larger calculus a circular spot, about half an inch in diameter, was covered with a thick flocculent layer of fibrous tissue, and on closely inspecting the mode of union between the fibrous tissue and calculus,

* Vol. vi, p. 250.

it was seen to be effected by the fibres dipping into and being incorporated with the calcareous substance. It was so firm that it resisted separation by tearing with the forceps."

The same volume contains an interesting case of encysted stone, which would equally have been inaccessible to lithotomy as to lithotrity. A small calculus had been crushed and removed, but the symptoms of stone soon returned with severity. The man was most carefully examined under chloroform, yet no stone or fragment could be detected. He died, worn out with pain and debility. The mucous membrane of the bladder was highly congested; the organ itself thickened and contracted; while a moderate sized calculus was detained in the superior fundus by an apparently permanent hour-glass contraction of the muscular fibres.

If it were possible to detect, during life, the impaction of a stone from hour-glass contraction, as above noticed, recourse to the high operation might be, perhaps, justifiable; it is the only operation which affords the least chance of relief.

When the stone is partially encysted, attempts have been made to liberate it from the cyst. Collot succeeded in one case by changing the position of his patient, and surgeons are sometimes fortunate enough to grasp and dislodge it with the forceps. In one case, Sir B. Brodie succeeded in dilating the neck of the sac with a probe-pointed bistoury, after which he separated the calculus from the sac with his finger, and extracted it. When the cyst is within reach, we may attempt to dilate the neck, and dislodge the stone with the

finger; but if that cannot be done, the operation should, I think, be abandoned. Division of the neck of the sac with a cutting instrument should not be attempted.

A source of difficulty not unfrequently arises to prevent the seizure of the stone and its extraction, from the forcible contraction of the bladder upon it, which the introduction of the forceps, and attempts to find the stone, tend to provoke. This impediment sometimes considerably prolongs the operation, and even occasionally prevents its completion; the danger being increased in proportion to the length of time occupied in the attempts. In these cases, by waiting a little, the contractions of the bladder will often cease, and permit the removal of the stone with facility; whereas, on the other hand, the repeated introduction of instruments, and the fruitless attempts to seize the stone, when the surgeon is anxious to perform the operation quickly, without due regard to the difficulties he may encounter, will, in many cases, excite still more the contractility of the bladder, and thus prevent the desired object. Mr. Crosse mentions, in his work, a case where three quarters of an hour were uselessly employed in attempts with the forceps to find a stone, of the size of a pigeon's egg, which came out of itself some time after they had been discontinued.

If the stone breaks under the forceps, as will probably happen when there is a fusible calculus, we must endeavour to remove as much of the calculous matter as is practicable with the scoop at the time of the operation, and then well wash out the bladder. We

must not, however, be content with washing out the bladder at the time of the operation, but should repeat this proceeding before the wound in the perinæum closes. In a patient of my own, fifty-six years of age, in whom the stone was like a mass of mortar, more than an hour was occupied in removing with the scoop the calculous matter; but a great deal was still left behind. I feared the consequences of protracting the operation, and the patient was removed to bed. At the end of a fortnight, I introduced a large catheter through the urethra, and well washed out the bladder, a great deal of lime escaping through the wound in the perinæum. I repeated this every other day for three weeks; in fact, until no more calculous matter escaped. The patient entirely recovered. Dr. Snow administered the chloroform at the operation, and at each washing out of the bladder.

The size of the calculus exercises a most important influence on the results of lithotomy. Difficult as may be the extraction of an impacted calculus, still more so is that of one so large as to require for its passage incisions longer than those usually made. A stone of from four to eight ounces in weight, cannot be safely removed without the greatest coolness and skill. If the size of the stone be such that no dilatation of the wound as first made will admit of its extraction it may be crushed; or the right lobe of the prostate may be divided, or a combination of both these proceedings may be adopted. If the blades be sufficiently strong, a well-made forceps will break most urinary concretions; but a variety of cutting forceps of different lengths,

some straight, others curved, with blades flat, and broad, or narrow, spoon-shaped, rough, or cutting, should always be at hand. Mr. H. Earle paid particular attention to the subject of extracting large calculi, and has communicated to the profession some interesting matter in the eleventh volume of the 'Transactions of the Royal Medical and Chirurgical Society.'

Cheselden withdrew a calculus of twelve ounces, and succeeded in curing his patient; Mr. Hamer, of Norwich, removed by lateral section a stone of the weight of fifteen ounces, its diameter being four inches and three quarters in one direction, and three and a half in the other.

In 1818, Mr. Charles Mayo, of Winchester, operated upon a man aged twenty-eight, and extracted a stone of fourteen ounces and two drachms avoirdupois. It measured eight inches and a half in its smaller circumference, by rather more than ten in the largest, and broke into several large pieces in the attempt to extract it.

Ambrose Paré relates the case of a confectioner, who was cut in 1570, by John Collot, where the stone weighed nine ounces, and was three inches and a half in diameter. In an instance described by Folet, a calculus weighing ten ounces, and measuring nearly four inches in diameter, was extracted, and the patient had recovered from the immediate effects of his wound, when an abscess formed in the kidney from the presence of a concretion, and terminated fatally on the tenth day from the operation.

The influence which the size of the calculus has upon the mortality after the operation of lithotomy, is

a point which has of late years attracted considerable attention. The cases related above are exceptional. It is well known that the extraction of a very large stone is generally fatal to the patient; but we have scarcely any data from which we can deduce the relative influence exerted by stones of different sizes. The late Mr. Crosse was the first writer who viewed this subject as one of interest and importance, and who had materials at his disposal from which other than either purely individual or extremely general inferences could be drawn. From the valuable Norwich data, Mr. Crosse* has presented us with the following table of 704 calculi, arranged according to the weight, with the result of the operations performed for their removal.

Weight.	Number of Cases.	Cured.	Died.	Ratio of Mortality.
1 oz. and under	529	482	47	1 in 11·25
1 to 2 oz.	119	101	18	1 in 6·61
2 to 3 oz.	35	19	16	1 in 2·18
3 to 4 oz.	11	4	7	1 in 1·57
4 to 5 oz.	5	2	3	1 in 1·66
5 to 6 oz.	2	2	0	0 to 2
6 to 7 oz.	2	0	2	2 to 2

The information which this table conveys is extremely important. With a stone one ounce in weight and under, it is obvious that the chances of a favorable issue are nearly twice as great as with a stone between one and two ounces in weight, and nearly six times as great as when the stone weighs between two and three

* Op. cit. p. 162.

ounces. The mortality with stones of every weight over an ounce, is nearly 1 in $3\frac{3}{4}$ths; and with those over two ounces it is something more than 1 in 2. Of the 55 instances in which the stone weighed two ounces and upwards, 27 recovered, and 28 died. The chance which a patient has for recovery after lithotomy can therefore be calculated beforehand, and independent of every other consideration, from the ascertained dimensions or weight of the stone. Doubtless, some considerable portion of the greater comparative success that attends lithotomy in early life is due to the generally smaller size of the stones that are then extracted.

A certain moderate size of stone, however, would seem rather to be advantageous than otherwise; the most favorable results are not associated with the smallest stones, as is apparent from the particulars conveyed by the following table taken from Mr. Crosse's work.

Weight.	Number of Cases.	Cured.	Died.	Ratio of Mortality.
1 dr. and under	134	122	12	1 in 11·17
1 to 2 drs.	111	101	10	1 in 11·10
2 to 3 drs.	95	90	5	1 in 19
3 to 4 drs.	68	60	8	1 in 8·50
4 to 5 drs.	29	28	1	1 in 29
5 to 6 drs.	38	35	3	1 in 12·66
6 to 7 drs.	24	21	3	1 in 8
7 to 8 drs.	30	25	5	1 in 6
Total . .	529	482	47	1 in 11·23

With stones under two drachms in weight the mor-

tality is therefore greater than with those that are between two and three drachms, and particularly with those between four and five drachms: the chances of recovery with this last weight of stone are actually about two and a half times greater than with a stone that weighs less than a drachm.

Measurements of calculi would be far more important elements in forming estimates of this kind than weight: it is the size of the stone that determines the extent of outlet necessary to give it passage, and this extent of outlet it is that influences the mortality: large stones often weigh less than might be inferred from their size; small ones, again, are frequently remarkably solid and heavy.

From what has been said, it is evident that for the extraction of calculi beyond a certain size, the lateral operation must be modified; in other words, when the surgeon finds he cannot extract the stone through the ordinary incisions, without employing a dangerous degree of force, he must employ other expedients. The operation may be abandoned for that above the pubes or through the rectum; the stone may be broken in the bladder; or the opposite side of the prostate may be divided, so as to obtain more space for the extraction of the calculus. I prefer this latter method whenever it can be employed with any prospect of success, and have had recourse to it with favorable results in two cases, where the calculi were large; but we must not forget that it does not enable us to gain much beyond half an inch for the required space. The plan which I adopt is the following: After the division of the left portion of the prostate, and the withdrawal

of the staff, I introduce my left forefinger, as far as I can into the wound, carry along it the button-headed bistoury, and divide the right side of the gland in the same manner as the left.

Breaking up the calculus with a forceps introduced through the wound is a very old operation. Even Franco, and after him Le Cat, attempted to facilitate the process by drilling the stone, and thus performed perineal lithotrity. There are, however, many strong objections to this method; it is lithotrity performed under the most unfavorable circumstances, and is more likely to lead to fatal results than if the crushing instrument had been introduced through the urethra.

Having thus noticed the principal obstacles to the performance of lithotomy, we are prepared to appreciate many of the accidents which attend or follow the operation.

That these are numerous and severe may be gathered from the general fact that about one fifth or one sixth of all patients cut for stone die. The accidents may occur during the operation or after it. The former are few; indeed, the only one likely to occur is injury to the rectum, an accident of no great importance, and not always to be attributed to the surgeon. The chief accidents occur sooner or later after the operation, and may be regarded as the causes of death. They are hæmorrhage, infiltration of urine, suppuration or abscess, cystitis, peritonitis, purulent infection, and renal disease.

The shock is also an occasional cause of death, or rather it was, for since the introduction of chloroform, this accident has lost much of its gravity, and seldom gives rise to a result immediately fatal.

The parts concerned in the lateral operation are

abundantly supplied with blood-vessels, and we might hence conclude that hæmorrhage must be a frequent accident. My own experience, however, would lead me to infer that dangerous hæmorrhage does not occur frequently; and Mr. Liston has stated that he had only one case of severe bleeding in one hundred operations. On the other hand, the accident appears to be much more frequent in France. Boyer considers hæmorrhage as one of the most frequent accidents of lithotomy, and M. Begin calculates that one out of every four deaths, after the lateral operation, is occasioned by hæmorrhage.

This accident may occur during the operation or after it, and the bleeding may be venous or arterial. Hæmorrhage during the operation may arise from division of the larger arteries of the perinæum and bulb, or of the trunk of the internal pudic itself. Where the external incision is carried too far downwards towards the ramus of the ischium, the trunk of the pudic artery may, it is said, be divided; but I cannot help thinking that this must be an extremely rare accident. The artery lies so close to the bone, and is so well protected by dense fascia that it can scarcely be wounded, unless there be some deviation from the normal course and distribution of the vessel.

The researches of modern anatomists show, that the arteries of the perinæum are subject to several important variations. These I have fully described in another work, and without repeating what I have already said, may express my belief that most cases of fatal primary hæmorrhage may be traced to the cause now mentioned. A greater quantity of blood than usual may ensue on division of some of the superficial vessels;

but in the normal state of things, these vessels do not bleed profusely, and can be easily secured.

Venous hæmorrhage may occur, during or soon after the operation, from division of the bulb, or, more commonly, from division in old persons of the venous plexus which surrounds the neck of the bladder. Sir B. Brodie lost a patient within a few hours from this cause, having been foiled in all his efforts to arrest the bleeding.

Secondary hæmorrhage may be, in some sort, a continuation of the bleeding which took place during the operation, the divided vessels continuing to pour out blood in small quantities. More usually it commences about the fifth or sixth day. The discharge of blood is often moderate, yet it continues obstinately, sometimes bringing the patient to the brink of the grave. Many surgeons attribute this form of hæmorrhage to the separation of the sloughs in the wound; but the most rational cause has been pointed out by Cruveilhier, who traces the secondary bleeding, in most cases, to the effect of inflammation of the mouths of the divided vessels. Under the influence of this inflammation the walls of the vessels become relaxed, the clot is detached and secondary bleeding is very likely to ensue.

In the treatment of this accident, general principles must be followed. If considerable hæmorrhage arise during the operation from any large vessel, it should be tied if possible, but it is not easy to get at the artery of the bulb and still less so the internal pudic. When ligature is impracticable, the vessel should be compressed against the ascending ramus of the ischium.

Secondary hæmorrhage, as I have shown, may be

either venous or arterial. In the former case, the wound may be carefully plugged, yet this is sometimes inefficacious and often produces great irritation, besides preventing the escape of urine. To obviate these difficulties, Mr. Hilton has contrived an apparatus which consists of an ordinary tube (such as those employed after lithotomy by Liston and others), to which is attached, by means of a ring, fixed about an inch and a half from its extremity, a conical bag of oiled silk. One end is passed up through the wound into the neck of the bladder, and the other end is left projecting externally, the cavity of the bag being filled with sponge, so as to exert pressure on the surrounding parts. In this way the wound may be most effectually plugged, while the free escape of urine is provided for. When it is thought safe, or becomes necessary, to remove the pressure, the sponges may be taken out, one by one, without the least pain to the patient, as they are prevented, by an intervening layer of oil-silk, from adhering to the sides of the wound.

In a case for which it was devised, the expedient answered admirably. As had been expected, there occurred after the extraction a rather free oozing of venous blood, which was, however, completely arrested by the plan described.*

In cases of secondary arterial hæmorrhage the most certain remedy would be to take up the vessels, but this can seldom if ever be done. The surgeon must have recourse to plugging the wound, pressure on the trunk of the main vessel, cold, and the usual modes of arresting hæmorrhage.

* Medical Times, May 19th, 1855, p. 490.

The most frequent cause of death after lithotomy, is infiltration of urine into the cellular tissue of the pelvis, and this accident is intimately connected with the methods adopted for division of the prostate.

The direction which should be given to this incision, and its extent, are points of the greatest importance to the success of lithotomy.

Cheselden is supposed to have divided, in his operation, as little of the prostate as possible.

The first account we have of Cheselden's* operation, is in his Appendix to the fourth edition of the 'Anatomy of the Human Body,' which appeared in the year 1730. In this Appendix, after describing the first stage of the operation, he goes on to say: "I then feel for the staff, and cut upon it the length of the prostate gland straight on to the bladder, holding down the gut all the while, &c., &c. In the Appendix to the fifth edition of 'Anatomy,' published ten years later, viz., in 1740, the description is the same, till we pass the the words, "I then feel for the staff," when he proceeds —"holding down the gut all the while with one or two fingers of my left hand, I cut upon it in that part of the urethra which lies beyond the corpora cavernosa urethræ, and in the prostate gland, cutting from below upwards to avoid wounding the gut." Dr. Yelloly, in a learned and able paper, published in the fifteenth volume of the 'Medico-Chirurgical Transactions' (London, 1829), speaks of these two operations as identical. If the words in which they are described be taken in their most simple signification, however,

* Willis, l. c.

it seems to me that the two operations are totally different. In the one (the first), the prostate is cut in its whole length, and the knife in the groove of the staff is passed from before backwards into the bladder; in the other, the second and latter operation, the knife is entered through the distal edge of the prostate only, and the membranous part of the urethra is slit open from behind forwards. The first method is the lateral operation of the English surgeons of the present day: the second method has scarcely, if it has ever, been intentionally performed since Cheselden himself ceased to operate; nevertheless, that it was the one which he approved there can be no doubt; for it is that with which his most brilliant successes were achieved, and it is that which is found in the next and only other edition of the 'Anatomy,' which appeared during his lifetime, namely, the sixth, which issued in 1750.

Mr. Martineau, one of the most successful lithotomists of modern times, divided only a part of the prostate. Mr. Crosse,* who witnessed for many years Mr. Martineau's public practice, says, "that he (Mr. Martineau) seldom, if ever, divided the prostate through its entire depth, is the opinion I have formed from observation of many operations by him, and which is supported by the only dissection I had the opportunity of making; still, enough was cut to allow the blunt gorget to enter the bladder, and then the operator invariably adopted a proceeding which forms no unimportant part of the operation; the staff being with-

* On the Formation, Constituents, and Extraction of the Urinary Calculus.

drawn, he was accustomed to introduce his left forefinger (which was particularly long and large) upon the concavity of the gorget, into the bladder, forcibly dilating the opening, and using the finger as a powerful but safe instrument for rendering the neck of the bladder ample to admit the forceps. The force and determination with which the finger was thus used, dilating, if not lacerating, the remaining undivided portion of the prostate gland and the neck of the bladder, I always regarded as a peculiar and intrinsic part of Mr. Martineau's method of operating. The opening into the bladder being thus effected, partly by cutting and partly by dilating, the forceps usually entered readily, and in the use of these, rapidly carrying them to different parts of the bladder if required, or more frequently seizing at once the stone (previously felt, and its situation ascertained by the finger), Mr. Martineau possessed a degree of freedom and dexterity unparalleled within my observation, and surpassed most surely by very few among those who have become conspicuous in this branch of operative surgery."

Whatever may be the difference of opinion respecting the mode of making a passage into the bladder, the dangers of completely dividing the prostate are apparent. The urine, escaping into the loose cellular tissue of the pelvis, produces inflammation and gangrene, and the patient almost certainly dies, labouring under symptoms of a typhoid character.

Infiltration of urine, generally the result of a too free division of the prostate gland, produces inflammation, suppuration, and sloughing of the cellular tissue of the pelvis. When it occurs, there is heat and pain

at the neck of the bladder, with pain behind the pubes; the face expresses anxiety; the pulse is small and weak; the tongue brown, furred, and dry; the wound glazed, the discharge fetid. Prostration rapidly comes on, and the patient dies in a few days after the operation. The treatment is obvious, though too often of little avail; a free outlet should be made for the extravasated and infiltrated urine by enlarging the external incision; the patient's strength should be supported by beer, wine, brandy, beef-tea, and whatever nutriment he can take. A gum elastic catheter should be retained in the bladder, that the urine may pass off as soon as it enters this organ. Abstraction of blood is inadmissible, the patient's strength being too much reduced; but hot fomentations may be applied to the hypogastric region.

Acute inflammation of the bladder sometimes occurs after lithotomy, but I can by no means agree with Boyer that it gives rise to three fourths of the deaths after that operation. This may have been so formerly; it is not assuredly the case now. Under ordinary circumstances we have little to apprehend from cystitis. This complication is not likely to occur unless the bladder has been previously inflamed, or injured by the forceps during the extraction of a calculus in difficult cases.

Peritonitis is still rarer; yet I have seen a few cases, characterised by the usual symptoms, viz., rigors, flushings, pains of undefined nature in the limbs; pain and tenderness in the umbilical region. The attack usually proves fatal on the third or fourth day. There is not always much room for treatment, the patient being

considerably reduced by the operation. The application of leeches, and the administration of calomel and opium so as to affect the gums, are the usual remedies; but opiates here are of great avail when given in full doses, and continued so as to produce a decided and prolonged effect.

Mr. Crosse, whose experience was large, says, "that as a separate malady, unaccompanied by urinary infiltration and diffuse reticular inflammation, peritonitis is, according to my experience, not frequent; it is known by the usual signs, and commences in the vicinity of the bladder, where the pain is first felt spreading thence over the peritoneal surfaces; the most active antiphlogistic treatment, by bleeding, low diet, fomentation, and counter-irritation, are required, and, if promptly and early practised, will arrest the disease. In children, who are rarely sufferers from diffuse reticular inflammation and urinary infiltration, peritonitis occurs, and yields to active treatment, particularly leeching freely the abdomen; but in the aged, urinary infiltration and reticular inflammation and suppuration are frequent in comparison with unmixed peritonitis; the surgeon seldom has to treat the latter, and when the combined diseased action is present, I must repeat that general bleeding and purging sink the powers without arresting the malady, and should be very guardedly undertaken by the surgeon."

Inflammation of the prostatic veins, followed by purulent infection of the blood and death, has been invariably described by French authors amongst the causes of a fatal termination in lithotomy. It is said to be much less frequent in this country; but further researches are required to determine whether this be

the case. It is certain that since the attention of surgeons has been directed to this subject numerous cases of purulent infection after lithotomy have been observed in the London hospitals and published in the journals.

In connection with this interesting matter, it is important to notice a point which has been too much overlooked. Purulent infection may arise from other causes besides phlebitis. The presence of pus in any part of the genito-urinary system is sufficient to determine the affection under the influence of operations performed on the urethra or bladder. I have seen it arise from ulceration with secretion of pus in the urethra, and likewise from the pus contained in a cyst in the bladder. Abscess of the prostate has also been a determining cause of the infection after lithotomy. These facts prove that we must not be content with examining the venous system alone, but should direct our attention to all the sources whence the introduction of pus into the blood may take place.

Disease of the kidney often follows lithotomy, and terminates in death. In the majority of these cases we may fairly assume that the disease existed in a latent state previous to the operation, which hastened death, but was not its immediate cause. The long-continued irritation of the bladder kept up by the presence of the stone sufficiently explains the frequency of renal disease, or at least a tendency to disease in the kidney, which the slightest exciting cause may light up.

The nature and symptoms of renal disease are now much better understood than formerly, and their exist-

ence can be determined with greater certainty. Yet this increased knowledge often adds to the embarrassment of the surgeon; for the patient urgently demands relief, while the practitioner has acquired the conviction that the operation will most probably hasten the fatal result.

The after-treatment in cases of lithotomy is simple, provided no accident has occurred during the operation. The patient is placed on his back in bed, with the knees slightly raised, and is kept as quiet as possible. The surface of the wound does not require any application; it will be sufficient to keep the parts clean and dry by removing the napkins, sponges, &c., whenever they are wetted by the urine.

It is a matter of great importance that the urine should escape freely through the wound soon after the operation. To ensure this object many surgeons are in the habit of passing a gum-elastic tube through the wound into the bladder, and securing it by tapes round the waist; the tube is kept in for about twenty-four hours, if the patient be a child; from forty to fifty hours if an adult. Mr. Liston was a strong advocate for this practice, which presents some advantages, but it is not absolutely necessary, and the presence of the tube may excite irritation of the bladder, which is always to be avoided: I never adopt this plan myself.

Retention of urine sometimes occurs after this operation. When this is the case immediate relief should be afforded by passing a gum-elastic catheter, or the finger through the wound as far as the neck of the bladder. Warm fomentations and opiates will assist in

relieving any pain or irritation to which the retention may have given rise.

For the first three or four days the diet must be light, consisting of beef-tea, milk, arrow-root, &c., with plenty of any bland fluid to drink. About the fourth or fifth day the wound begins to contract, and then some urine begins to escape through the natural passages. In one case on which I operated, a considerable proportion of the urine passed through the urethra on the morning after the operation. As the wound gradually contracts more urine is discharged by the urethra, until at last the whole takes the natural course.

From this time the external wound begins to close, and the cure is completed in from thirty to forty days. As the case progresses favorably the diet must be gradually improved, and it is well to remember that children and aged persons will require support at an earlier period than others.

The Transverse or Bilateral Operation may be viewed as a modification of the lateral operation. It was first described by Chaussier, and performed, in 1824, by Baron Dupuytren.

The patient is placed in the same position as for the lateral operation, an assistant holding the staff in an exactly vertical direction. The surgeon keeps the integuments tense with the fingers of his left hand, and, with a double-edged knife, makes a semilunar incision in front of the anus. This incision commences on the right side, between the anus and right ischium, ascends towards the raphé, and terminates on the left side, on a

level with the point whence it set out. The middle point of the semilunar incision should traverse the raphé, about ten lines in front of the anus. It involves the skin, the superficial perinæal fascia, and the anterior fibres of the external sphincter ani. The left fore-finger is now passed into the wound, and guides the knife during a second incision, which lays bare the membranous portion of the urethra; the nail now guides the point of the knife into the groove of the staff at this part, and the membranous portion is opened transversely to the extent of two or three lines, in order to avoid any danger of wounding the rectum. The extremity of the double lithotome is next introduced into the groove of the staff through the small incision alluded to, with its convexity turned towards the rectum; and once fixed in the groove, it is pushed on into the bladder. The staff is now withdrawn, and the lithotome turned so as to present the concavity downwards; the blades are opened, and the instrument withdrawn in a perfectly horizontal direction. The parts divided in this second stage of the operation are the membranous portion of the urethra, along the median line, the prostate, and the neck of the bladder, on both sides, in a nearly transverse direction, and to an extent proportioned to the separation of the blades of the lithotome.

Dupuytren attributes many advantages to this method of operating, yet it is not likely that it will ever replace the lateral operation.

Tested by results, we find that Dupuytren lost 9 male patients out of 38 on whom he operated, or 1 in 4·22; of 47 operations performed by Sanson, Roux, and other French surgeons, 10 proved fatal.

Professor Eve, of Nashville University, United States, has kindly favoured me with an account of 22 cases in which he performed the bilateral operation; only 4 patients died, or 1 in 5·50.

Allarton's Method. — The Marian method, or the "Apparatus Major" as it has sometimes been called, consisted in makiug a nearly vertical incision into the spongy or membranous portion of the urethra, on a grooved staff, in introducing certain instruments into the bladder through the incision, and then forcibly dilating the parts, until a sufficient opening was obtained for the extraction of the stone. In 1727, Dr. Douglas suggested that the urethra might be opened in the perinæum, and dilated so as to extract any stone without cutting the bladder or lacerating the structures concerned in the operation. The subject was again taken up, in 1796, by Deschamps, who proposed a mixed method, resembling the lateral operation in the external incisions, and the Marian method in dilation of the prostate and neck of the bladder; he suggested that the integuments, &c., should be divided obliquely until the knife reached the membranous portion of the urethra; this was opened and the prostate slightly nicked, after which the parts were dilated in a very slow and gradual manner. It is curious to find the celebrated lithotomist exclaiming, with prophetic spirit, "who knows but at some future time surgeons may not be tempted to return to this method?" Mr. Allarton has the credit of yielding to the temptation and fulfilling the prophecy.

His operation he thus describes:—"I introduce a grooved staff, of the usual size, and confide it to an

assistant, with directions to keep it perpendicular and hooked up against the pubes; I then introduce the index finger of my left hand into the rectum, placing its extremity in contact with the staff, as it occupies the prostate, and press it firmly against the staff so as to steady it; then, with a sharp-pointed, straight knife, with a tolerably long and rough handle, *I pierce the perinæum* in the middle line, about half an inch above the anus, or at such a distance as may appear necessary to avoid dividing the fibres of the sphincter. I carry the knife steadily and firmly on till it strikes the groove of the staff, the deep sphincter lying between the knife and the directing finger, which latter enables me to judge of the distance as the knife passes along. Having struck the groove of the staff, I move the point of the knife along the groove towards the bladder a few lines, and then withdraw it, cutting upwards, so as to leave an external incision of from three quarters of an inch to an inch and a half, according to the presumed size of the stone. The escape of urine indicates the entrance to the urethra. I then introduce a long, ball-pointed probe, or wire, through the external opening into the groove of the staff, and slide it into the bladder, to sufficient depth to insure its safe lodgment in that viscus, and withdraw the staff. I then well grease the index finger of the left hand, and pass it along the probe, with a semi-rotatory motion, through the prostate into the bladder; and when the stone is free it comes at once into contact with the finger, and, *if of moderate size, passes readily into the wound on withdrawing the finger*, the patient having power to strain upon, and thereby facilitate the extraction of the stone; this last-mentioned power being one

of the great advantages of this operation." The author then goes on to observe that, "the incision being strictly in the median line, no muscles are divided, and no gaping-open wound is left, as in the lateral section. The integrity of the bladder being preserved, and no chloroform given, the patient himself helps to expel the stone."

This operation must, like all others, be judged by experience. It has succeeded in some cases, and failed in others.

CHAPTER XXII.

LITHOTOMY AND LITHOTRITY IN THE FEMALE.

The operations performed for the removal of calculi from the female bladder, require a separate notice, and I shall therefore devote a chapter to them.

Women are not very subject to stone in the bladder, at least, not so much so as men.

Several reasons may be assigned for this difference. Women are more regular in their habits, and not addicted to those excesses, which, as I have shown, by increasing the proportion of nitrogenous elements in the body, promote the deposit of uric acid. For the same reason they are little subject to gout. It is also evident that the shortness and dilatability of the urethra, its peculiar form, the absence of a prostate, and several other anatomical circumstances facilitate the passage of small calculi through the female urethra and prevent the developement of the complaint.

Admitting, with all writers, the comparative rarity of calculus in the female, I believe that it exists oftener than is generally supposed. The following are the principal statistical facts which I have been enabled to collect in illustration of this point. Mr. South informs

us that in 146 cases operated on at St. Thomas's Hospital, from 1822 to 1845, 144 were males, and only 2 females.*

This gives a proportion of 1 female to 72 males, which is greatly below the average. In the Norwich collection of 704 calculi, 669 were taken from males, and 35 from females, or from 1 female to 19 males.†

This agrees closely with the proportion observed at the Hotel-Dieu, from 1808 to 1830; 284 calculous patients were operated on, of whom 17 were females, giving a proportion of 1 to 16 males.‡

From the various tables collected by M. Civiale, I find that the proportions in Italy, out of 1104 operations, were as 1 female to 18 males; and in France, out of 2834 operations, as 1 to 22 males. These various statistics agree sufficiently to enable us to conclude that the proportion of females to males, at least amongst those who are submitted to operations, is about 1 to 20.

The methods employed for extracting calculi from the female bladder may be arranged under three heads — those in which a cutting instrument alone is employed; those in which we have recourse to dilatation of the urethra; and a mixed method, composed of incision and dilatation.

The first of these methods is the oldest, and the urethra and neck of the bladder have been divided in every possible direction.

Celsus recommended the operation to be performed in

* Chelius's Surgery, vol. ii, p. 635 (table).

† Crosse, Treatise on Urinary Calculi, &c. London, 1835.

‡ Civiale, Traité d'Affection Calculeuse. Paris, 1838, p. 594.

the following manner. For girls, the fingers were passed into the rectum, and for women into the vagina. The calculus was thus pressed forwards against the neck of the bladder, and a transverse incision was made directly on the foreign body either below and to the left of the meatus, for girls, or between the meatus and os pubis, for women.

The objections to the Celsian method are self-evident; yet it was revived in 1823, with some modifications, by M. Lisfranc.

The Marian method took the place of Celsus's operation, and like it, was nothing more than a clumsy attempt to apply as nearly as possible to females the method adopted for males. A grooved catheter was introduced into the urethra, and its convex surface made to project towards the point to be incised; an assistant drew aside one of the labia to expose this point, and the operator then cut down on the urethra, commencing his incision about a finger's breadth from the femur, between it and the meatus. Having cut into the urethra, the dilating instruments were introduced, and the operation terminated as for the male. The Marian method was hence made up of incision and dilatation, and all that has been ever done since was to subdivide this mixed method; some surgeons advocating incision alone, and some dilatation, while others adhered, and still adhere, to the ancient principle of combining both.

Franco appears to have followed the method of Celsus, and was an opponent of dilatation; yet that great surgeon was acquainted with the advantages of the modern operation, and says that when the stone

is small, or not requiring too much dilatation of the urethra, it may be extracted without cutting. It is not easy to say who originated the method of dividing the urethra or neck of the bladder, without making a lateral external incision, as Celsus and Marianus did. The first clear account of such an operation is to be found in the works of Ambrose Paré, who saw the elder Collot perform it. A grooved staff was introduced into the urethra, and on it a small incision was made vertically upwards through the neck of the bladder. The forceps were then introduced, and the incision dilated until sufficient space was obtained for the extraction of the stone.

Sir B. Brodie revived the original operation of Collot, and divided the membrane of the urethra under the symphysis pubis directly upwards, after which he dilated with Weiss's instruments.

The same objection holds good against this operation as against all those in which the opening is made between the urethra and pubes; viz., that it necessitates the extraction of the calculus where the space is smallest.

This mode of simply dividing the urethra from within outwards having been thus introduced and made known through Ambrose Paré's works, operators set about modifying it, but their ingenuity did not seem to get beyond the very simple step of changing the direction of the incision. Some cut sideways, some obliquely down, some directly down, while some divided both sides of the urethra.

Dionis, I believe, was the first who proposed the double incision of the urethra with a narrow bistoury;

he divided the orifice of the urethra horizontally on both sides, proportioning the extent of the incision according to his notion of the size of the stone; he then introduced a dilator, and gradually expanded the urethra and neck of the bladder; but, in spite of the care with which he operated, Dionis informs us that three-fourths of the women remained affected with incontinence of urine, and that this accident was inevitable whenever the calculus was large.

Mr. Liston and other surgeons have introduced modifications of Dionis's operations. The principle is the same: Mr. Liston notched the neck of the bladder on both sides towards each ramus of the pubis, and then continued the dilatation for a few minutes, until the finger could be admitted into the bladder.

Another modification proposed is somewhat similar. A straight staff having been introduced into the bladder, the groove being directed downwards and to the left side, a straight probe-pointed bistoury is passed along the groove until it has nearly reached the bladder; it is then drawn outwards, and the anterior half or two-thirds of the urethra divided, as the bistoury is withdrawn. If the stone be large, a slight notch may be made in the right side of the urethra, somewhat similar to the first incision, dilatation being effected with the fingers.

The vertical incision directly downwards has been principally recommended by Professor Chelius, of Heidelberg. It may be made with a common bistoury or the lithotome caché. A grooved staff is passed into the bladder, and its concavity made to press downwards. The cutting instrument is then carried along the groove

into the bladder, dividing directly downwards, and in the mesial line the urethra, the corresponding wall of the vagina, and the neck of the bladder. Chelius affirms that the free cut does not increase the danger of incontinence of urine; while vesico-vaginal fistula is not more to be dreaded than after the common mode of dividing the bladder and vagina.

Le Dran divided with a particular instrument the neck of the bladder obliquely downwards; and this method is the one usually employed at the present time, except that the wall of the urethra is also divided in the same direction. It has been called the "lateral operation," and nothing can be more simple or easy of execution. A straight staff is passed into the bladder; the operator then grasps the handle of the staff and directs its groove downwards and outwards towards the ramus of the ischium; a probe-pointed bistoury is now passed into the groove of the staff, and the whole length of the urethra divided; the neck of the bladder may also be divided by the same incision if it be supposed that the size of the calculus requires it. The oblique incision often intersects a small portion of the anterior wall of the vagina.

The facility of arriving at the bladder through the vagina, must have suggested at an early period the operation now denominated vagino-vesical.

The patient is placed in the usual position; a straight staff is passed into the bladder, the groove is directed downwards, and the end of the staff made to press against the vagina; the index finger of the left hand, and a wooden gorget are also passed into the vagina, and the end of the staff is made to rest fairly in the

concavity of the gorget. Both instruments are now firmly held together by an assistant, and the operator directs along his left fore-finger the point of a straight bistoury until he arrives at the groove of the staff behind the neck of the bladder, when he carries his incision forwards to the extent judged proper. The great probability that vagino-vesical fistula will result, is the main objection to this operation.

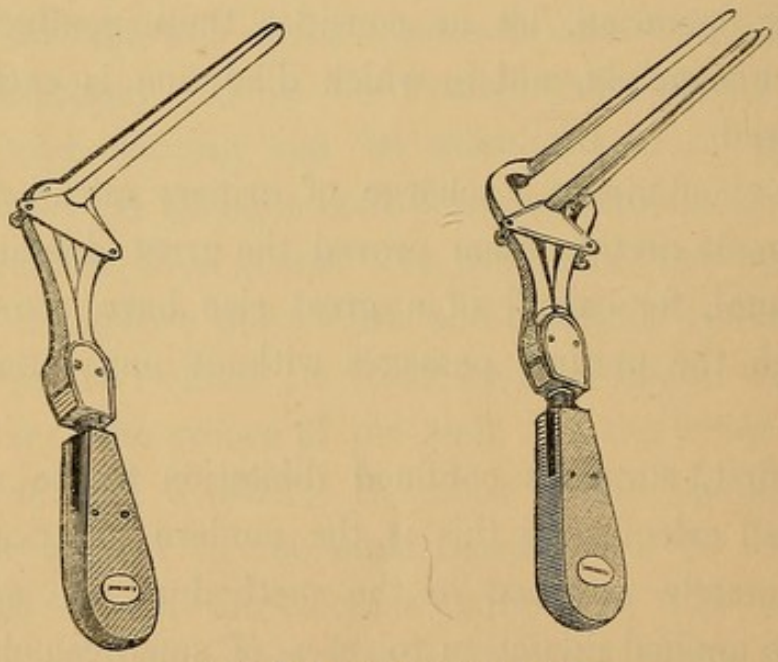
Having thus described the various methods of extracting stone from the female bladder by means of a cutting operation, let us consider those conducted on another principle, and in which dilatation is exclusively employed.

The spontaneous discharge of urinary calculi through the female urethra soon proved the great dilatability of that canal, for calculi of a great size have come away through the natural passages without any interference of art.

At first, surgeons confined dilatation to the removal of small calculi, and this is the modern practice. We have merely returned to the method of the ancients. Franco applied dilatation to cases of small calculi. His successors, however, soon went further. In the seventeenth century, Jannot practised dilatation alone, but this method did not prevail long. Experience demonstrated at once the inconveniences arising from excessive dilatation of the neck of the bladder, and surgeons returned to the only sound practice, viz., that of confining this method to small, or at most moderately-sized calculi.

Some surgeons recommend the dilatation to be effected with solid or flexible bougies; and I perceive that Dr.

Gross, in his recent work, says he prefers gum-elastic catheters. Dr. Douglas proposed using pieces of prepared sponge, and this method continued in vogue for a considerable time. Other operators dilated with a blunt gorget, and Sir Astley Cooper, who was a great advocate of dilatation, used to employ an instrument constructed on the principle of the speculum oris or speculum ani. In this country we now usually employ the dilator made by Mr. Weiss.



WEISS'S FEMALE DILATORS.

INSTRUMENT CLOSED. INSTRUMENT OPEN.

The kind of instrument, however, is of much less importance than the kind of dilatation. Should it be rapid, in order to avoid the tediousness and pain which sometimes, during this process, are intolerable? or should it be slow and gradual to avoid the risk of entailing on the patient incontinence of urine? These are points on which professional men are not yet fully agreed.

Perhaps the safest practice to pursue in case the surgeon adopts dilatation, is that recommended by Sir Astley Cooper, who says, "If the stone be small the dilatation should be accomplished in a few minutes; but if it be large it will be better to dilate only a little from day to day, until the greatest degree of extension is accomplished." Dupuytren remarks, "That rapid dilatation is not much more painful than the slower, but that it is much more likely to be followed by incontinence of urine." It cannot, however, be denied that this is a tedious and disagreeable method, and hence many surgeons, even where the calculus has been large, have not hesitated to dilate the urethra in what may be called a rapid manner. Thus, Mr. Howard relates a case* in which he extracted a stone, weighing more than two ounces, from a female twenty-three years of age. The urethra was dilated with Weiss's instrument for two hours only, after which the foreign body, which measured two and a quarter by one and a half inches in its several diameters, was extracted without any difficulty. The cure, it is true, was only an imperfect one, for the woman was unable to retain more than half a pint of urine at a time, and this is the great objection to nearly all the methods adopted for the extraction of calculi from the female bladder. A considerable proportion of those operated on labour ever afterwards under the distressing accident of incontinence of urine.

Many surgeons contend that dilatation is less likely to be followed by incontinence of urine than division

* Lancet, Sept. 27th, 1855.

of the parts, while many other excellent surgeons hold the directly opposite opinion. My own impression is, that division is less likely to entail this infirmity than excessive dilatation; but, on the other hand, lithotomy in the female is by no means the harmless operation that we are generally told it is.

As the subject of lithotomy in the female has given rise to so great a diversity, not only of opinion, but of practice, amongst the best surgeons, I have thought it right to lay the various methods fairly before the reader. My own opinion is, that the lateral operation, as it has been called, should be abandoned altogether, and I am disposed to lay aside likewise the more modern process of nicking the neck of the bladder or slitting up the urethra.

For small calculi I would employ dilatation only; and large calculi I would break up with the lithotrite into small fragments, which will either come away of their own accord or can be reduced to still smaller pieces.

It is curious to observe the phases through which lithotrity has passed in its application to females. When this method of operating was first introduced, the enemies of lithotrity pretended that it was only applicable to the female. In one of the early editions of M. Velpeau's 'Operative Surgery' I find the following passage:—"Lithotrity is performed on the female with infinitely greater ease than on the male, and it is almost free from danger; the female urethra being wide, short, and dilatable, without any curvature, without prostate, or seminal orifices, is admirably fitted to give passage to the instruments, and it is not necessary to

reduce the calculus into such small fragments." Yet after having such a favorable opinion as this, M. Velpeau subsequently declared, and still insists, that lithotrity is not applicable to female patients. He would exclude women as well as children from the benefit of the operation. In England there existed some prejudice also against the application of lithotrity for the cure of calculus in the female; but it is rapidly giving way, and on considering the arguments adduced, the only one of any force which I can discover is that drawn from the supposition that the female bladder is incapable of retaining the fluid injected into it previous to the operation.

The conditions of simplicity which distinguish the female urinary apparatus from the male, render the introduction of instruments so easy that it is unnecessary to enter into any examination of the obstacles which may present themselves during this part of the operation. Still it may be well to remark that the orifice of the meatus urinarius is narrow in some females, so much so, that the operator may experience some difficulty in getting the point of the lithotrite into it. This obstacle, however, is of little importance. The orifice of the meatus can be easily dilated by means of bougies; nor can any great inconvenience arise from nicking it with the bistoury if judged necessary. In some cases the urethra is more or less contracted along its whole length, and in a very irritable condition from sympathy with the disordered bladder. Although such a condition occurs much less frequently than in the male, and never reaches such a degree of intensity as when depending on disease of the prostate, or the neck of the bladder in males, it still requires

attention, and should be combatted by the ordinary means which I have already described.

The female bladder is less liable to become seriously diseased than the male from the effects of calculous irritation, and the obstacles arising from enlargement or disease of the prostate are, of course, entirely absent in the female. However, the depression just behind the neck of the bladder, caused in the male by tumefaction of the middle lobe of the prostate, sometimes exists in the female also, though from a different cause. The lateral walls of the female bladder are naturally depressed, and in an aged patient this may be carried so far as to form a kind of sac at the floor of the bladder in which the calculus or its fragments are apt to lodge. In addition to this, M. Civiale observes that the uterus sometimes presses against the posterior and inferior walls of the organ, dividing its floor into two pouches in which the fragments may likewise become engaged. It is well to bear these circumstances in mind, although any obstacle which they can create is far from having the same importance as those produced by enlargement of the prostate in the male. The canal of the urethra is so short and straight in the female that every portion of the bladder can be explored without any great difficulty, and the conditions of each case ascertained with a degree of precision which renders the task of the operator comparatively light.

The operative proceeding is the same for the female as for the male, and the indications relative to disease of the urinary organs are also the same for both sexes. I need not, therefore, repeat what has been already said on this latter point; but I may remark that lithotrity

has been successfully applied to cases of stone in the female bladder under circumstances which would certainly have contra-indicated the operation in the male. There are two principal reasons for this; in the first place, the operation, can be terminated, *cæteris paribus*, much more rapidly in the female than in the male; it is easier to seize the calculus; it is easier to crush the calculus into fragments. All these advantages render it much less likely that the operation will be followed by irritation of the urinary organs, or by any dangerous accidents.

In the second place, the fragments of the calculus are much less liable to be retained in the bladder or to become impacted in the urethra; and I have already shown that many of the evil consequences of an operation in the male depend on the irritation excited by these two accidents.

In the female they are rare. There is no enlarged prostate to impede the free evacuation of the detritus; no curved canal to arrest their discharge, while the great dilatability of the urethra in the female renders it less necessary to break up the calculus into very small fragments, and thus contributes to render the operation less protracted in difficult cases.

The main objection brought forward in this country against the expediency of applying lithotrity to the female is derived from the alleged difficulty of making the female bladder retain the fluid injected into it.

It would certainly appear from many cases on record that some operators have found it impossible to make the female bladder retain the fluid which they injected; and hence, adopting the false method of reasoning from

particulars to universals—they reject lithotrity altogether for the female. It may happen that the bladder of a female patient is small, contracted, excessively irritable, and incapable of retaining the injection. This occurs in the female as well as in the male, though I believe less frequently, and when it does occur lithotrity should not be undertaken. But this is no reason for converting the exception into a rule. Under ordinary circumstances the female bladder will retain the injection well enough, and if the bladder show any disposition to reject it, this can be overcome by elevating the pelvis a little more than usual, and by diminishing the quantity of fluid thrown in. The rapidity with which the operation may be completed in the female, renders it much less necessary to have the bladder distended with fluid.

The same instruments may be employed for the female as for the male, or they may be slightly modified. There is no necessity for having the female lithotrite as long as the male instrument, and it is probable that the facility of working may be increased by having the extremity more scoop-shaped than in the lithothrites commonly used. Since the last edition of this work was published, lithotrity has been frequently applied in the London hospitals to the removal of calculi from the female bladder and with most satisfactory results.

CHAPTER XXIII.

STATISTICS OF LITHOTRITY AND LITHOTOMY.

The statistics of lithotrity are chiefly confined to the results which M. Civiale and Sir Benjamin Brodie have published.

It is well known that the statistics of M. Civiale have been submitted to severe criticism, both in this country and in France; but it must be borne in mind that the identical statistics of M. Civiale, first reported on by M. Doubois, were again submitted for examination to a committee of the Institute, in 1835; that MM. Larrey and Doubois were members of this committee, as they had been of the former one, and that they permitted M. Civiale to state, without contradiction, that he had lost only 6 in 257 cases. This statement was printed under the authority of the Academy of Sciences, and since then M. Civiale has been elected a member of the Institute of France.

The following is a tabular view of M. Civiale's results:

1824 to 1846. Calculous Patients.	No. of Operations.	Deaths.	Proportion.
848	591	14	1 in 42·21

The ages in 512 cases were as follows :

Age.	Cases.
1 to 20 years . . .	25
21 to 40 „ . . .	80
41 to 50 „ . . .	124
51 to 60 „ . . .	44
61 to 80 „ . . .	234
81 to 90 „ . . .	5
Total . .	512

This table shows a large proportion of aged patients; the mortality is one in $42\frac{1}{5}$, a result which no lithotomist can pretend to approach.

M. Civiale's statistics embrace two periods, one from 1824 to 1836, during which 305 operations were performed, and the number of deaths was 7. During the second period, from 1836 to 1846, 276 operations were performed, and the number of deaths was also 7.

In the second series of cases, the mortality is set down at 7 also. M. Civiale does not attempt, however, to conceal the fact, that 10 other patients, on whom lithotrity had been commenced, died. These patients were not included in the general table, because the operation had not been persevered in, the cases after a few trials having been found unsuited for lithotrity. Many may be disposed to think that they

should have been comprised in the general table, and if this had been done, we should have had a total of 591 operations, and 24 deaths, or 1 in 24; a result with which the most sanguine advocates of the method may be content.

Sir Benjamin Brodie has also published a statistical account of all his operations, but without entering so much into details as M. Civiale.

The results may be expressed in the following simple form:

No. of Cases.	Deaths.	Proportion.
115	9	1 in 12·77.

In five of the cases death resulted directly from the operation, and in four it was attributable to the co-existence of some other disease brought into activity by the shock of the operation.

In three of the five cases first mentioned death arose from urinous abscesses; in one from cystitis, and in one from fever and general irritation. In three out of the four cases where death resulted indirectly, the co-existing disease, which subsequently proved fatal, was seated in the kidney. In the fourth case the patient was cut off by diarrhœa not positively connected with the operation, but included in the list by Sir Benjamin Brodie, apparently to prevent all cavil.

The mortality was 1 in $12\frac{3}{4}$. Yet in all fairness the last case should be deducted, leaving the mortality as 1 in 14·37 of the cases operated on.

Lithotrity has been frequently performed in France by MM. Leroy d'Etiolles, Heurteloup, and Amussat, but they have not published a complete account of their cases. Of those given by M. Leroy, we find 11 deaths in 116, while M. Heurteloup asserts that he lost only 1 patient in 38. Of the first 112 operations performed in Italy, 9 proved fatal.

Professor Campanella states that 10 patients were treated by lithotrity in the hospital of Loretto between 1834 and 1839, and all recovered. Seven of them were above 40 years of age.*

The statistics of lithotomy are much more complete, for here we are aided by numerous hospital returns and registers. They illustrate various interesting questions connected with the subject of calculous disease in general.

The general mortality of lithotomy may be determined, as closely as the materials permit, from authentic returns published by a few practitioners and from several public institutions. Collecting these together I have constructed the following table :—

* Repertorio di Piemonte. August, 1839.

GENERAL MORTALITY AFTER LITHOTOMY.

Locality.	No. of Operations.	Males.	Females.	Deaths.	Proportion of Deaths to Cases.
Luneville Hospital.	1492	1433	59	141	1 in 10·58
*Hotel Dieu, 1808 to 1830	100	95	5	28	1 in 3·57
*La Charité, 1806 to 1831	70	.	.	35	1 in 2
*Beaujon, *La Pitié, *Maison de Santé	56	53	3	18	1 in 3·11
*Ten Departments of France	110	.	.	24	1 in 4·58
Private patients in Paris in 10 years:					
Dupuytren's table	356	.	.	61	1 in 5·19
*Austria	133	.	.	25	1 in 5·32
*Bavaria	136	.	.	28	1 in 4·85
*Lombardy	1044	.	.	217	1 in 4·81
Naples	308	298	10	47	1 in 6·80
*Wurtemberg	120	120	.	7	1 in 17·14
*Bohemia	36	.	.	4	1 in 9
*Dalmatia	40	.	.	4	1 in 10
*Roman States	33	.	.	3	1 in 11
*Sardinia	21	.	.	6	1 in 3·50
*Sweden	36	.	.	5	1 in 7·20
*Denmark	35	.	.	12	1 in 2·91
*Cork Infirmary	15	.	.	0	
St. Thomas's Hospital.	144	.	.	15	1 in 9·60
Bristol Infirmary	354	347	7	79	1 in 4·48
Leeds Infirmary	197	.	.	28	1 in 7
Norwich Infirmary	704	669	35	93	1 in 7·57
Radcliffe Infirmary, Oxford	101	95	6	13	1 in 7·76
St. Mary's, Moscow	411	.	.	42	1 in 9·78
Pennsylvania Hospital	83	.	.	10	1 in 8·30
Dupuytren's Bilateral Operation	42	38	4	9	1 in 4·56
Cheselden	213	.	.	20	1 in 10·65
Liston	115	.	.	16	1 in 7·18
Total	6505	3148	122	990	1 in 6·56

From the above table it would appear that the general mortality of lithotomy is 1 in 6·55, or about 2 in every 13 cases. The returns from the Luneville Hospital were published by Castara; those from Moscow by Dr. Roos, of St. Petersburg; those marked with an asterisk by M. Civiale, in his work on calculous disorders.

The principal causes of death after lithotomy have been explained in a preceding chapter, where it was asserted that the probability of a fatal result increases in proportion to the size of the stone and the age of the patient. It is interesting to test this by statistics. The following table is composed from the returns furnished by Castara, Mr. Smith, of Bristol, Mr. Crosse, Cheselden, Dupuytren, and Mr. South:

Age: Years.	No. of Cases.	Deaths.	Proportion.
1 to 10	1466	112	1 to 13·08
11 to 20	731	71	1 to 10·28
21 to 30	205	31	1 to 6·61
31 to 40	141	24	1 to 5·83
41 to 50	123	27	1 to 4·50
51 to 60	161	44	1 to 3·65
61 to 70	126	39	1 to 3·23
71 to 80	19	7	1 to 2·71
Total .	2972	355	1 to 8·37

The above table illustrates very clearly the influence of age on the mortality of lithotrity. Below ten years of age the mortality is 1 in 13, and gradually augments with each decennial period to 1 in 10, 1 in 6, 1 in 5, 1 in 4, 1 in $3\frac{3}{4}$, 1 in $3\frac{1}{4}$, 1 in $2\frac{3}{4}$.

Notwithstanding the favorable results obtained at the Luneville Hospital (1 in 10), and by Dupuytren (1 in 18), on children below 10 years of age, those of Cheselden and the surgeons of St. Thomas's Hospital stand out in extraordinary relief. Cheselden lost only one patient out of 35 under 10 years of age; and on analysing the cases published by Mr. South, in his translation of Chelius, I find that during a period of 23 years at St. Thomas's Hospital, the mortality at the same period of life was only 1 in 58. This, perhaps, is the most brilliant success of which modern surgery can boast.

ST. THOMAS'S TABLE.

144 Cases in all; in 19 no age given—1 in 9·6.

Age.	Cases.	Deaths.	Proportion.
1 to 10	58	1	1 in 58
11 to 20	26	3	1 in 8·86
21 to 30	7	1	1 in 7
31 to 40	6	1	1 in 6
41 to 50	4	1	1 in 4
51 to 60	9	2	1 in 4·25
61 to 70	9	3	1 in 3
71 to 81	5	2	1 in 2·50
Total .	125	14	1 in 9

Age not given for one death.

It is generally agreed that the size of the calculus exercises a marked influence on the result of lithotomy. The size cannot be correctly estimated from its weight, though it may approximatively. The only statistical

returns which we possess on this point are due to the late Mr. Crosse, who weighed all the calculi in the Norwich collection, and having compared the weights with the registered results of each case, drew up the following tables:

INFLUENCE OF WEIGHT OF CALCULUS ON RESULTS OF LITHOTOMY.

FROM MR. CROSSE.

Weight.	Cases.	Deaths.	Proportion.
Up to 1 oz.	529	47	1 in 11·25
1 oz. to 2 „	119	18	1 in 6·61
2 „ 3 „	35	16	1 in 2·18
3 „ 4 „	11	7	1 in 1·57
4 „ 5 „	5	3	1 in 1·66
5 „ 6 „	2	0	0 in 2
6 „ 7 „	2	2	2 in 2
Total . . .	703	93	1 in 7·56

WEIGHTS OF CALCULI IN ONE HUNDRED FATAL CASES.

FROM MR. CROSSE.

Weights.	Deaths.
Up to 1 oz.	50
1 to 2 „	22
2 to 3 „	17
3 to 4 „	5
4 to 5 „	3
5 to 6 „	0
6 to 7 „	2
Above 7 „	1

The above returns are highly instructive. They show how rare is the occurrence of a calculus weighing more than four or five ounces; and, on the other hand, they indicate the influence which the size of the stone exercises on the result of the operation, the mortality increasing in nearly the same ratio as the weight.

The following tables may be interesting as an attempt to illustrate the mortality of lithotomy according to the different methods employed:

APPARATUS MAJOR.*

Locality.	Cases.	Deaths.	Proportion.
La Charité, 1720-1727	208	71	1 in 2·83
Hôtel Dieu, 1720-1727	604	184	1 in 3·27
La Charité, 1731-1735	71	32	1 in 2·21
Total	883	287	1 in 3·08

HIGH OPERATION.†

Ages.	Cases.	Deaths.	Proportion.
1 to 20 years	38	9	
20 to 50 „	8	3	
50 to 70 „	18	5	
70 to 80 „	19	6	
Age not indicated . .	21	8	
Total	104	31	1 in 3·35

* Morand, Traité de la Taille.

† Mr. Humphry, Addenbroke's Hospital, Cambridge.

THE BILATERAL OPERATION.*

Ages.	Cases.	Deaths.	Proportion.
1 to 10 years	15	1	1 in 18
11 to 20 „	3	0	
20 to 50 „	3	1	3 in 5
50 to 70 „	2	2	
Total	23	4	1 in 5·75

On adding these tables to those which I have already given, the following view of the mortality, according to the method employed, is obtained—

* Report from Professor Eve, of Nashville University.

MORTALITY OF LITHOTOMY ACCORDING TO THE METHOD EMPLOYED.

Method.	Cases.	Deaths.	Proportion.
CHESELDEN'S OPERATION.			
St. Thomas's Hospital .	144	15	
Bristol Infirmary . . .	375	79	
Leeds Infirmary . . .	197	28	
Norwich Infirmary . .	704	93	
St. Mary's, Moscow . .	411	42	
Pennsylvania Hospital .	83	10	
Cheselden	213	20	
Liston	115	16	
Total . . .	2242	303	1 in 7·38
APPARATUS MAJOR.			
Hôtel Dieu & La Charité, 1721—1731 (Morand)	883	287	
Luneville Hospital . .	1103	119	
Total . . .	1986	406	1 in 4·89
HIGH OPERATION.			
(Frère Come)	69	15	
(Mr. Humphry's table)	104	31	
In all France :			
M. Civiale's table . .	95	41	
Total . . .	268	87	1 in 3·08
RECTO-VESICAL METHOD.			
(M. Civiale's table) . .	185	38	
Total . . .	185	38	1 in 4·87
BILATERAL METHOD.			
Dupuytren	89	19	1 in 4·68
American Surgeons* . .	118	13	1 in 9·
Total . . .	207	32	1 in 6·46

* Dr. Gross, l. c., p. 625.

Dr. Gross has given an interesting table of operations performed by American surgeons, from which I select those exceeding forty in number :

Operators.	Cases.	Deaths.	Proportion.
Dr. B. W. Dudley .	207	6	1 in 34·50
Dr. Valentine Mott .	162	7	1 in 23·28
J. P. Mettauer. . .	91	4	1 in 22·75
W. Gibson	50	6	1 in 8·33
N. R. Smith . . .	45	3	1 in 15
S. D. Gross . . .	40	3	1 in 13·33
	595	29	1 in 20·51

These results are highly creditable to the skill of American operators.

M. Pamard has published* an account of all the operations performed by his father and himself at Avignon, since the year 1792.

They amounted to 72, of which 6 proved fatal. The causes of death were as follows: 1 from laceration of the bladder; 1 from hæmorrhage; 1 from cystitis; 3 from purulent infection of the blood; 24 of the patients were under 10 years of age, and relapse of the calculous formation occurred in 6 cases.

* Revue Med. Chir., May, 1849.

CHAPTER XXIV.

SOLUTION OF STONE.

Various attempts have been made to dissolve stone in the bladder, sometimes by internal remedies, administered by the mouth, at other times by chemical agents thrown directly into the bladder.

Fourcroy and Vauquelin first laid down rules for the selection of those remedies which might exert the most favorable chemical action. The uric acid calculus was to be dissolved by the diluted alkalies; the phosphatic by the diluted hydrochloric acid; the oxalate of lime by the diluted nitric acid.

Mrs. Stephens acquired a great reputation for discovering a remedy which was supposed to dissolve stone in the bladder, and for which she received a large sum from the Government. Many cases were recorded in which it was stated to work marvels, not only by dissolving the stone, but also by removing various unpleasant and distressing symptoms connected with renal and vesical diseases. As is now well known, it was found to consist of Castile soap and egg-shells.

Dr. White, of Edinburgh, relates the following case in a small work entitled 'Essay on the Virtues of Lime

Water and Soap in the cure of Stone.' "David Miller had long been the subject of stone in the bladder, which had caused him the most excruciating sufferings. After trying a great variety of medicines, he took Castile soap, to the amount of an ounce and a half daily, washed down with three pints of lime water. He soon experienced great relief, and after passing several fragments of stone, was considered cured. When he died, at the end of eleven years, no stone was discovered."

The waters of Vichy have been tried as solvents for stone, and it seems also undeniable that in several persons in whose bladders the presence of calculi had been ascertained by sounding, the symptoms were relieved or removed, while using the water internally.

M. Chevallier was the first who instituted direct experiments on the powers of the alkaline water of Vichy, to dissolve and disintegrate urinary calculi. The following are the particulars of some of his trials:

1. A quantity of uric acid gravel was subjected to the action of the Vichy water, kept at a temperature of 97° F. The concretions were speedily destroyed; the uric acid being entirely dissolved, and nothing remaining suspended in the fluid but a few loose flocculi of animal matter.

2. The half of an uric acid calculus, weighing 1 ounce, 1 drachm, 36½ grains, was placed in a little bag of wire muslin, and subjected to the action of the Vichy water*

* There are seven principal springs which pour out these waters, the product of each differing but little from that of the rest. The composition is as follows:—

Water . . .	from 991·9 to 994·9	
Carbonic acid gas .	1·2	0·93

during 151 hours: dried carefully and weighed after this, the calculus was found reduced 2 drachms, 52 grains, so that in less than a week it had actually lost 6 drachms, 47 grains, or more than two thirds of its original weight.

3. In another experiment, five calculi, one of phosphate of lime, weighing 1 drachm 18 grains; a second of uric acid, weighing 1 drachm, 8; grains a third of uric acid, weighing 25 grains; a fourth and fifth, fragments of phosphatic calculi, weighing the one 29 grains, and the other 13 grains, were enclosed together in a bag of fine muslin, and exposed, on the 5th of September, to a constant stream of Vichy water, of the temperature of about 98° F. On the 11th September, the bag being examined, was found completely empty; the calculi of uric acid had been dissolved, those of the phosphates disintegrated, and their particles washed through the meshes of the muslin.

Contrary to the usually entertained opinion, M. Petit found that, on the whole, calculi of the triple phosphate of ammonia and magnesia lost most under the action of the Vichy water, *i. e.*, of a solution of bicarbonate of soda in water, supersaturated with carbonic acid, than those of the uric acid. For example, five specimens of uric acid calculi, weighing together a little more than

Carbonate of soda	. from	5·5 to	4·7
Carbonate of lime	.	0·6	0·3
Carbonate of magnesia	.	0·9	0·6
Muriate of soda .	.	0·47	0·52
Sulphate of soda .	.	0·47	0·27
Silica .	.	0·04	0·04

7 ounces and 416 grains, after remaining, on an average, twenty-seven days exposed to the action of the water, lost very nearly 53 per cent. of their original weight; but five specimens of the ammonio-magnesian phosphatic calculus, which, together, weighed rather more than 6 ounces and 14 grains, and only remained under the action of the water, one with another, for the space of twenty-three days, lost 60 per cent. of their original weight.

M. Petit, like M. Chevallier, found that the Vichy water had extremely little influence on calculi composed of oxalate and phosphate of lime. This water, however, would dissolve cystine and xanthic oxide calculi, with at least as much readiness as it disintegrates and dissolves those of lithic acid and the triple phosphate. Water surcharged with carbonic acid, and holding a little bicarbonate of soda in solution, is consequently a solvent for the calculi of every description that are of somewhat frequent occurrence, save those of the oxalate of lime. Such a water will, therefore, it is affirmed, attack something like nineteen twentieths of all the known varieties of urinary concretions.

The destruction of urinary calculi by an alkaline water is found to be not merely, nor, perhaps, even principally by way of solution; it is accomplished in a considerable degree, especially as regards those of the triple phosphate, by a kind of disintegration of their component particles. When calculi, which consist principally of the oxalate or phosphate of lime, are mingled with a little lithic acid, lithate of ammonia, or triple phosphate, which often happens, the alkaline water attacks and disintegrates them rapidly, so that the sphere of its activity is still further extended.

From several experiments performed by my colleague, Mr. Alexander Ure, it would appear that an excess of carbonic acid lessens the solvent power of the alkali; and that the bicarbonates have less effect than the carbonates.

Mr. Ure recommends the borate of potash, in the dose of three grains to the ounce of water; there is no use in making the solution stronger.*

The following case of the action of an alkali was presented last year to the Harveian Society by Mr. Ure:

The patient, a gentleman advanced in years, infirm in health, and imbecile in mind, had been under the care of Dr. Hodgkin, who, suspecting from his symptoms the presence of stone in the bladder, recommended that a surgeon should be consulted. Mr. Ure was called in; and, on introducing a sound, at once detected a calculus. Having examined the urine, he found it to be turbid, acid to litmus paper, of specific gravity 1·021; when filtered, it became cloudy on exposure to heat, and on the addition of nitric acid; it contained the usual proportion of uric acid, and abundance of phosphates; numerous mucous corpuscles were discernible by the aid of the microscope. Owing to the enfeebled state of the patient's constitution, it was deemed unadvisable to resort to any surgical operation. Mr. Ure believing the calculus to be composed of uric acid, prescribed phosphate of soda to be given twice or thrice daily in infusion of uva ursi, with a little tincture of henbane. This treatment was persevered in for some months, with decided

* Provincial Med. Journ., vol. i, 1842, p. 116.

relief to the calculous symptoms. Eventually, the patient died under a gradual decline of the powers of life. A post-mortem examination was made by Dr. Hodgkin and Mr. Ure. On opening the cavity of the urinary bladder, a fragment of a calculus was discovered. This weighed ten grains only. It consisted of uric acid. It bore evident marks of extensive disintegration of its concentric layers, the surface being irregularly eroded, resembling the appearance of a calculus that has been exposed to the agency of a chemical solvent.

Mr. South also relates a case which was communicated to him by Mr. Travers. The patient, who had long laboured under symptoms of stone, was sounded by Mr. Travers a few years since; a hard calculus of some size was detected, and an immediate operation recommended. The patient refused, and placed himself under some person, who administered a "constitution water" to the extent of two or three pints daily. The patient now began to pass small fragments of the stone, and this continued for several months with acute pain during micturition. The pain and discharge of fragments at last disappeared. This man's body was examined after death, by Dr. Charles, of Putney, who could find no trace of the stone. Dr. Prout stated the basis of the drink to be carbonate of potass and soda, with a little nitre.*

The experiments, however, conducted by Pelouse, and related in vol. xiv of the Comptes Rendus of the Academy of Sciences, lead him to the following conclusions, which fully account for the decided want of success which has attended the use of solvents—

* South, l. c., vol. ii, p. 634.

I. The effects of different agents upon urinary calculi proceed very slowly, and are chiefly evident upon the animal matter which enters into their composition.

II. Drinks and baths never effect a cure.

III. The result of injections is problematical, and the danger of inflammation not counterbalanced, as in lithotrity, by a rapid destruction of the calculus.

IV. Although the combination of lithotrity with injections increases the probability of success, yet it is most advisable to proceed with lithotrity.

Dr. Hales endeavoured to prove by experiments that fluids, injected into the bladder by the urethra, were capable of diminishing the size of a vesical calculus. He invented a double catheter, which he used for washing out the bladder, and compared the fluid injected with that expelled after contact with the stone.

Dr. William Butler, of Edinburgh, instituted, in 1752, a series of experiments with lime water, and soon after a case occurred in the practice of Dr. Rutherford, which was reported to be attended with complete success.

In the 'London Journal of Medicine' for October, 1851, there is an interesting paper by Dr. Hoskins, of Guernsey, on the introduction of solutions of lead into the bladder for the decomposition of phosphatic calculi.

The adaptation of the principle of double decomposition to the disintegration of vesical calculus is in strict accordance with chemical usage; it supplies, says Dr. Hoskins, a class of agents, more energetic as regards the concretion, and less injurious to the organ in which it is contained, than any of the uncombined solvents

hitherto employed. The solvent, no matter how dilute, can only be tolerated for a minute or two at furthest, and cannot soon be repeated; the decomponent, on the contrary, is retained from ten to fifty minutes without discomfort, and may be repeated daily or oftener if necessary. The cause of this difference is sufficiently obvious; the active agent of the decomponent is liberated gradually, and neutralised by the earthy bases of the calculus before it can come in contact with the living tissues; whereas the former class of fluids causes such immediate irritation, that their ejection is required before any impression can be made on the concretion.

The *base* of the decomponent unites with the *acid* of the calculus, while the acids of the former combine and form soluble salts with the bases of the latter. The combined acids are set free in definite proportions, neutralised in their nascent state, and removed from the sphere of action before any stimulating effects can be exerted on the bladder.

Cases under the care of Mr. Guthrie, Mr. Aston Key, Mr. Copeland, and myself are recorded in this communication. On one occasion the rejected fluid contained eighteen grains of dry phosphate of lead.

Dr. Hoskins recommends the nitro-saccharate of lead for the purpose now under consideration. One grain of the salt, superacidulated with five drops of strong acetic acid is the proper proportion of admixture with each fluid ounce of water. It is essential that the salt and the acid should be incorporated before the addition of the water, and that the whole should be brought to the boiling point. Superacidulation is necessary on many accounts; it secures perfect solution,

increases the decomposing activity of the liquid, and prevents the formation of any carbonate of lead.

As the salts in the urine tend to decompose the solution, and lessen its effects on the concretion, the bladder should be evacuated, and washed out with tepid water before the solvent is introduced. A double current caoutchouc catheter is the best for this purpose, as it enables a continuous stream to be employed; and, on account of its flexibility, it is less liable to irritate the urethra, which should be sedulously avoided. From four to eight fluid ounces of the solution may be thrown into the bladder at a time, and renewed every ten or fifteen minutes, as often as may be deemed proper. By renewing the liquid at short intervals, much greater effect on the calculus is ensured than when the injection is allowed to remain a long time; for the precipitate formed by the decomposition soon envelopes the stone, and puts a stop to further action, until a fresh surface is exposed. Exercise, during the retention of the injection, increases its effects. Some slight reaction may be produced by the first introduction of this or any other fluid into the bladder; when such is the case, the operation should be remitted for a day or two, and cautiously renewed. The injection may be either warm or cold, as may be most agreeable to the sensations of the patient. Warmth favours the decomposition of the calculus.

Besides the kind of cases already adduced, Dr. Hoskins thinks there is one variety for which decomponents seem to be peculiarly adapted, viz., concretions in the prostate gland. No instrument, hitherto devised, has been successful in dislodging them. The first case,

however, mentioned in Dr. Hoskins's. paper, goes to prove that a considerable quantity of calcareous matter was removed from the prostatic portion of the urethra by the use of the lead injection.

From the well-known effects of the electric current as an universal solvent, it might have been supposed that some attempts would have been made with this agent to promote the solution of urinary calculi. Many years ago, Sir W. B. O'Shaughnessy made a series of experiments at Calcutta on this subject. He exposed calculi to a powerful and constant current for several days, without any practical diminution of their weight. The apparatus used was a glass cylinder, closed at one end by a membrane, and placed in a vessel containing urine, which was frequently renewed. A plate of platinum was inserted into each vessel, and connected with a 12-plate battery. The urine in contact with the calculus could thus be rendered acid or alkaline at will; still, without the desired effect being obtained. The great obstacle is the difficulty with which *solid* substances undergo decomposition.*

Mr. Robertson has proposed to substitute an electric discharge for the constant current, but no experiment has been made on a living body. In a word, this interesting part of the science is completely in its infancy.

* Bengal Dispensatory.

CHAPTER XXV.

ACUTE INFLAMMATION OF THE PROSTATE GLAND.

The prostate gland, one of the most important accessory secreting organs in connection with the generative system, is situated at the neck of the bladder, surrounds the urethra, and receives the termination of the ejaculatory ducts; it is a firm fibrous structure, containing a yellowish-white spot or cavity, analogous to the uterus of the female (uterus masculinus). The two lateral lobes, with their connecting central portion, consist of a fibrous capsule, derived from the deep pelvic fascia, and of a yellowish-gray structure, composed of flat muscular fibres, which penetrate into the substance of the organ, forming its greater part; the true glandular structure amounts, according to Kölliker, to only one third of the whole. In this network are contained the vesicles which secrete the prostatic fluid, about twelve or fifteen of which unite to constitute a lobule, giving off a single duct, which opens, independently of the others, into the urethra. The prostatic ducts are more numerous than have been supposed, but from their extreme tenuity, and from the fact that they can be only momentarily seen

when the secretion is being squeezed from them, their exact number is perhaps uncertain. The microscopical structure of the prostate bears some resemblance, according to Henle, to the salivary glands; and I may here observe that Cowper's glands possess a very analogous structure. The prostate is always small when the organs of generation are in an imperfect state; and it is subject to the same law of development which regulates the formation of the bladder or penis.

Numerous causes may either predispose to or excite acute inflammation of the prostate gland.

The pressure made by vesical calculi on the neck of the bladder, the constant irritation kept up by their presence, which, by the continuity of mucous tissues, is so readily transmitted to the prostatic portion of the urethra—act as predisposing causes to inflammation of the prostate itself. Of the same nature are the morbid secretions proceeding from vesical catarrh, or from a diseased kidney, which directly or indirectly act upon the prostate, and excite inflammation either in its follicles, or in the cellular tissue that envelopes them.

Another common cause of this inflammation is an old stricture in the urethra, and it rarely happens that the obstacle it presents to the free flow of urine does not produce inflammatory affections in the prostate, the intensity of which is usually in relation to the degree and extent of the constriction.

During the existence of a gonorrhœa, prostatic inflammation not unfrequently occurs. In this case, the discharge diminishes, or nearly ceases, as soon as the gland becomes inflamed, and the pain which was

confined to the anterior part of the urethra is referred to the perinæum, accompanied by a disagreeable sense of fulness and tenderness, increased by standing or sitting.

The internal use of the gum-resins and astringent injections employed in the treatment of gonorrhœa, are among the exciting causes of prostatitis.

Small calculi proceeding from the bladder, lodging among the prostatic lacunæ, and those concretions that not unfrequently form in the same situation, likewise produce prostatitis.

As the prostate partakes of the excitement of the venereal organism during sexual intercourse, we can easily conceive how excessive venery may be an occasional cause of the same affection.

Exposure to wet, particularly of the feet, or the immersion of the feet in cold water, especially in rheumatic subjects, are apt, where there is predisposition to the disease, to produce acute inflammation of the prostate.

Too nutritious and highly seasoned viands, and the excessive use of vinous and spirituous liquors, can sometimes be traced as giving rise to prostatic inflammation.

Cantharides are well known as inflammatory excitants of the genito-urinary system, whether employed externally or internally, and often produce inflammation in the prostate.

Persons who are obliged to travel much on horseback are often the subjects of prostatitis, which is occasioned by the constant friction and concussions to which the perinæum is exposed.

This disease very often affects those of opposite pursuits—the man who sits for a long time in his counting-house, and the student who too often neglects to obey the call to stool, or to satisfy the natural desire to empty the bladder.

Worms situated in the lower bowel have been observed at times to cause considerable irritation in the prostate, which is allayed only by the expulsion of those entozoa. But besides worms, other causes, which keep up a continual irritation in the rectum, are capable of exciting inflammatory action in the prostate, such as habitual and obstinate constipation. The same cause will also produce a varicose state of the prostatic veins, as well as of those of the extremity of the rectum. During the efforts of defecation, the venous blood, being forced towards the lower part of the pelvis, distends the veins and makes them varicose; and thus the prostate is increased in bulk, independently of any lesion of its tissue.

The abuse of those purgative medicines which act principally on the rectum, as aloes, may give rise to disease of the prostate. In cases of dysentery also, in which there is much congestion of the rectum, the prostate may become inflamed from contiguity.

Sir E. Home considered the disease as entirely local, produced by local violence, kept up by local circumstances, and having all its symptoms aggravated by a succession of causes of irritation belonging to the organs to which the prostate gland is attached.

The incipient symptoms of acute prostatitis are characterised by uneasy sensations in the perinæum, soon followed by an increased desire to expel the urine, while

at the same time the patient is unable to satisfy the calls in a complete manner. These symptoms soon become more acute. The pain in the perinæum is more severe, and extends in various directions, shooting down the thighs, to the lumbar region, or often extending towards the anus, or along the urethra. The pain in this form is particularly increased by pressure on the perinæum.

There is frequent micturition and scalding in making water, which are increased as the acceleratores urinæ contract to expel the last drops of urine. Evacuations from the bowels also cause great uneasiness, and there often remains a sensation as if the rectum was not completely emptied, giving rise to distressing tenesmus. If the finger be introduced into the rectum, the gut is felt hot, and the prostate seems a smooth, round, and hard body, projecting downward on the bowel, and exceedingly painful to the patient under pressure of the finger.

The inflammatory action, if not checked, shortly extends to the neck of the bladder, and, not unfrequently, to its whole inner lining; then total retention of urine frequently succeeds; intense febrile symptoms supervene, accompanied with delirium; and in this stage the patient may die, if the bladder be not relieved, and the inflammation not subdued.

If a catheter or sound be introduced into the bladder, it passes without any difficulty, or causing uneasiness, as far as the membranous part of the urethra; but its passage through the prostatic portion is attended with most acute pain, and gives rise to severe spasmodic contraction. All the above symptoms are aggravated by violent exercise or fatigue.

If the inflammation has continued for seven or eight

days, and rigors then occur, with increase of febrile symptoms, quickened pulse, hot skin, furred tongue, &c., as well as with greater sense of fulness and tension in the perinæum, more frequent calls for, and greater difficulty of, micturating, it is most likely that suppuration is taking place. If at this period we examine the prostate through the rectum, we shall no longer find it hard and resisting, but, on the contrary, it will be found to resemble the bladder, so that inexperienced persons would most likely be led into error; the examination per rectum, as well as the discharge of fæces, causes great pain; and there is constant tenesmus, with a burning sensation in the part.

The fibrous investment of the prostate, softened by inflammation, and distended by pus, bursts, and allows the escape of a creamy and sanguineous matter into the urethra, the rectum, or the bladder: then the tumour diminishes, the urethra becomes free, the urine flows in a large stream, and as the bladder empties itself, the patient feels his sufferings decrease.

If the abscess opens into the urethra, a very copious purulent discharge instantly manifests itself from this passage: the urinary discharge is accompanied, but more frequently preceded or followed, by the evacuation of a large quantity of purulent matter. After the last drops of urine are voided, there is a stinging pain, which lasts for a few minutes, or for a much longer period, according to circumstances. There is in some cases more or less blood mixed with the discharge, and I have known considerable hæmorrhage take place. There is also pain in the glans penis, as if a burning coal was applied to it.

Authors relate cases in which a single abscess in the prostate contained half an ounce or more of pus, such a case is mentioned by Petit; but more commonly the abscesses are of smaller size, and so numerous that after death the prostate presents a sieve-like appearance from their number and minuteness. When the abscess is of long standing, the pus is contained in smooth organized cysts, and extremely fetid. In other cases the fluid is of a light straw-colour, and of a cream-like consistency; with it is mixed some of the *débris* of the gland, and occasionally blood. The surrounding textures are softened, infiltrated by serum, and of reddish hue. They may be almost disorganized, and converted into a substance not unlike wet tow.

The abscesses, if unopened, make their way into the rectum, the bladder, or the urethra. They may involve, in the latter situation, the opening of the ejaculatory ducts, which would then be destroyed.

The matter is discharged mixed with the natural contents of these viscera, and the urine deposits pus in the form of sediment. But the abscess may burst into the peritoneal cavity at the posterior part of the prostate, and so cause fatal inflammation. The occurrence is marked by acute pain in the pelvic region, small pulse, rigors, and rapid prostration of strength.

When, through active and appropriate treatment, acute inflammation of the prostate terminates in resolution, all the symptoms above indicated diminish; at the same time, the liquid secreted by the follicles of the gland augments in quantity, and, mixing with the urine, in the form of a whitish or grayish viscid matter, settles at the bottom of the vessel without adhering to its sides,

having very much the appearance of imperfectly elaborated pus. This matter diminishes in its turn, and finally disappears, as the functions of the affected parts return to their natural condition.

Acute prostatitis demands the employment of the most active antiphlogistic treatment.

If the attack is severe, blood may be taken, by cupping, from the loins or perinæum. Leeches, moreover, may be applied above the pubes, particularly when pain is experienced there, or in the perinæum. The French practitioners recommend the application of leeches on the rectal surface of the prostate, by means of a speculum introduced into the anus.

Mr. William Craig* relates a case of diseased prostate in which he employed a particular method of applying leeches directly to the gland, differing both from those of Henderson and Begin. It consists of a tube into which is fitted a piece of wood, with a handle at one end, while the other terminates conically in a blunt point, for the purpose of gradually dilating the rectum. When this is effected, the wooden dilator is to be withdrawn, and a box of proper size to fit the tube, and capable of holding three or four leeches, with a piece of wire to form a handle fixed into the bottom of it, is to be pushed through the tube.

It is necessary to lubricate the wood and the tube with oil previous to using it, and, in introducing it, it should be directed towards the rectum in order to prevent its coming in contact with the tender prostate.

In elderly persons, the efficacy of taking blood is

* Lancet, vol. ii, Session 41—42, pp. 299, 300.

more doubtful, and the relief obtained by it is only temporary.

After depletion, morphia allays irritation, and assists in removing inflammation. Its preparations may be given internally, or may be used per rectum, and repeated so as to subdue irritation, the constipating effects being occasionally obviated by a previous enema of hot water, and by small doses of gentle aperients. "If, in defiance of these means," says Sir E. Home,* "the patient is unable to make any water, or, although able to pass a few ounces, is every hour obliged to make the attempt, and, with much straining, does no more than void the same quantity, such symptoms are most undoubtedly not to be allowed to go on, since by their continuance they are establishing a complaint which, if the symptoms are arrested in their progress, will get well. A flexible gum catheter should be passed without a stilet, in the most skilful manner, into the bladder, the smallest degree of violence being used that is consistent with the nature of the operation; and when the bladder is emptied the instrument should be retained in the bladder, the water being drawn off at regular intervals, not only till the first symptoms go off, but till the bladder can retain the water for the usual length of time, and the water, when voided, has the appearance of healthy urine. The means to be employed in preventing and assuaging pain are Dover's powder in different quantities, according to the urgency of the symptoms, and opiate clysters. As soon as the parts have recovered themselves, the catheter is to be

* Diseases of the Prostate Gland, vol. ii, p. 92.

withdrawn, and there is every reason to believe it will not be necessary to introduce it again on the present occasion."

Hot bathing generally, as well as locally, gives relief.

Febrile symptoms and constitutional derangement must be attended to, by withholding food, and permitting the use only of bland and diluent drinks.

Beer, coffee, and spirits should be refrained from, and exposure to cold or damp, or any sudden change of temperature, as much as possible avoided.

If an abscess forms it is desirable that the matter should find its way neither into the rectum, the urethra, nor behind the bladder, which may be fatal, but should pass to the surface, in order to discharge its contents more freely and heal more readily. We must not, therefore, hesitate, when fluctuation or any diffused swelling can be discovered in the perinæum, to make a free incision, without waiting for the matter to present at the surface.

Should the disease have anticipated the operator, and the abscess have opened into the perinæum or the rectum, nothing can be done beyond maintaining the general health. Should the abscess have burst into the urethra, or at the neck of the bladder, a flexible catheter ought to be retained in the canal until there is reason to believe the abscess is healed. Most commonly the matter gradually diminishes in quantity, and ceases after a time. In other instances the discharge disappears for a time, and then comes on, and this may occur several times before the patient completely recovers.

In these cases, ulceration of the surface of that portion of the prostate which projects into the bladder sometimes occurs. In this state, or even in that of mere enlargement, the gland is liable to bleed. This usually will cease by antiphlogistic treatment, and by keeping the patient entirely in the recumbent position.

CHAPTER XXVI.

CHRONIC ENLARGEMENT OF THE PROSTATE GLAND.

The most common affection of the prostate is chronic hypertrophy, which may involve the whole, or only part of the organ, producing changes in the neck of the bladder and in the urethra which interfere with the power of the patient to expel the urine. This change was formerly considered to ensue from chronic inflammation; and Verdier,* who in common with many other French authors, entertains this opinion, believes that frequently an attack of acute inflammation in the organ partially subdued, and not totally extinguished by the treatment which has been adopted, leads to a state of engorgement, which, either spontaneously or through some accidental excitement, resumes that action known, in its abated form, as chronic inflammation.

However, if we carefully examine the gland, we fail in detecting any of those changes commonly recognised as inflammatory, such as the effusion and organization of lymph, by which the component parts become glued together and rendered indistinct from one another.

Although the change which has taken place in the

* Obs. sur les Phlegmasies de la Prostate.

substance of the gland, resembles the mere effect of increased nutrition more than any other; yet it often presents appearances which cannot be referred to simple hypertrophy.

In the majority of cases the change goes on slowly, and at first imperceptibly; and the terms chronic enlargement, or hypertrophy, are not improperly employed to distinguish it from the inflammatory attacks to which the organ is liable.

I had an opportunity, not long ago, of examining minutely the condition of the prostate in a case of simple hypertrophy; in my examination I was assisted by Dr. Handfield Jones. The patient, a man seventy-two years of age, was admitted into St. Mary's Hospital with retention of urine. For the last two years he had suffered from frequent desire to pass urine, and incontinence, the result, in all probability, of an over-distended bladder. The day before his admission he was seized with total retention. Two pints of bloody urine were drawn off, and the catheter was afterwards regularly introduced, but irritative fever set in, and the man died five days after his admission. On examination, the parietes of the bladder were thinner than natural, the lining membrane highly injected, and its cavity much increased in size. The prostate was of a remarkable size, resembling a large orange. This condition of the gland was not the result of any inflammatory action in it, but merely of increased nutrition. Dr. Handfield Jones found the tumour to consist of much fibroid stuff, showing nuclei with acetic acid, in which there lay embedded numerous glandular follicles and vesicles not unfrequently containing young pros-

tatic concretions. It was essentially a prostate gland structure. Dr. H. Jones considers that the follicles which exist in the hypertrophied prostate communicate with the original gland-cavities, and are out-growths of the earlier existing follicles.

In a great many other cases, however, the gland is indurated as well as hypertrophied; and hence the error into which the older surgeons so frequently fell, of believing that the prostate was often the seat of scirrhous disease. In other cases the induration is partial, or depends on the presence of fibrous tumours, which are imbedded in the interior, and seem closely interwoven with its structure, as occurs in fibrous tumour of the uterus. Though an increase of density may be considered as the ordinary condition of an hypertrophied prostate, it may be softer than usual, when the ducts are dilated, and full of secretion, and the venous tissues more developed than in the healthy state. The fibrous capsule of the gland is often thickened; but in many cases it has been found reduced to a mere film from excessive development of the subjacent parts.

The opposite views relative to the nature of enlargement of the prostate are, in a great measure, reconciled by modern researches, which establish that the gland may be enlarged under two different circumstances. These are well pointed out by Dr. Hodgson,* in a monograph which I have received while these pages were going through the press.

In one variety the parenchymatous substance of the

* The Prostate Gland, &c., by Decimus Hodgson, M.D Churchill, London, 1856.

gland is enlarged; in the other, the glandular structure. Parenchymatous hypertrophy, according to Dr. Hodgson, is usually traceable to irritation about the neck of the bladder or prostatic portion of the urethra, giving rise to chronic inflammation of the gland. Hence, its principal causes are stricture, stone in the bladder, &c.

On making a section of the prostate affected with parenchymatous hypertrophy, the substance of the organ is found to be condensed and fibrous; but the precise seat of the change does not seem to be yet clearly ascertained. Dr. C. H. Jones thinks that the enlargement in these cases, depends on increase of the inter-glandular tissue, and especially of the muscular elements; but, as Dr. Hodgson observes, it is difficult to explain hypertrophy of muscular tissue by chronic inflammation.

This form of hypertrophy occurs at an earlier period of life than the glandular; it does not give rise to the same degree of enlargement; and it is usually accompanied by an indurated condition of the neck of the bladder; it is likewise much more amenable to treatment.

Glandular hypertrophy of the prostate is the form so commonly met with in persons of advanced age. It may extend to the whole gland, or be confined to certain lobes or even lobules. The nature of the change is here, likewise, involved in some obscurity. It appears to depend on simple enlargement of the glandular tissue, and this holds good with respect to those partial hypertrophies which were formerly mistaken for fibrous tumours. Rokitansky first pointed out that these tumours, though often so invested by fibro-cellular tissue that they may be enucleated, are composed of tissues

like those of the prostate gland itself. This observation has been confirmed by Mr. Paget; and Dr. Hodgson observes, with respect to general hypertrophy, "that the most experienced pathologists have failed to notice anything whereby the structure of the hypertrophied tissue may be distinguished with certainty from the normal gland.*

On the other hand, Mr. Henry Thompson, who has paid considerable attention to this subject, expresses his belief "that the increase in size commonly designated hypertrophy, is due far more to the extraordinary development of the natural fibrous elements, than to that of the true glandular structure; although it is unquestionable that increase of the latter, particularly in the form of independent growths, is sometimes met with." On the whole, judging from the various specimens which he has examined, Mr. Thompson concludes that, a tendency to the increased production of the fibrous tissues, furnishes the common solution of enlargement of the prostate gland.†

The changes in the size and form of the gland vary considerably in different cases. In some it is only slightly enlarged; in others, it attains the size of a man's first. Bartholin relates a case in which the gland is said to have equalled in size a man's head; this statement, however, is clearly loose and exaggerated. The parts most frequently affected are the lateral lobes, which, from their proximity to the urethra, influence very materially the length, the direction, and the diameter of the

* L. c., p. 47.

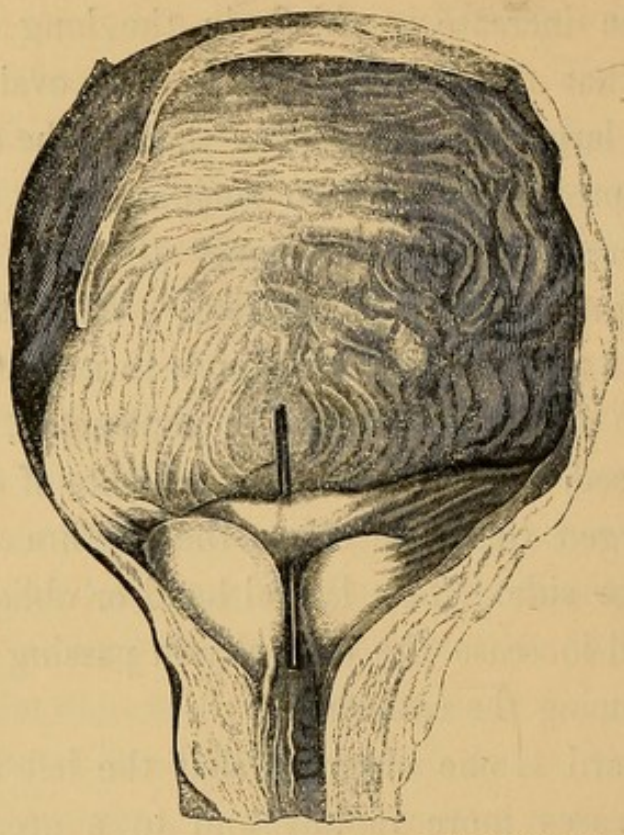
† Trans. of Path. Soc., vol. vii, p. 255.

canal. The increase is chiefly in the long axis of the organ, so that the lateral lobes become oval and elongated, and larger in the middle than at the extremities. They may project inwards to such a degree as to touch one another; or more commonly there is a median groove or gutter left between them. When the enlargement affects the glandular substance in its entire circumference, the urethra is flattened, contracted, and sometimes reduced to a mere longitudinal slit; if one lobe is more enlarged than the other, the urethra deviates to the opposite side. This lateral bend or obliquity in the passage will increase the difficulty in passing the urine, and introducing the catheter.

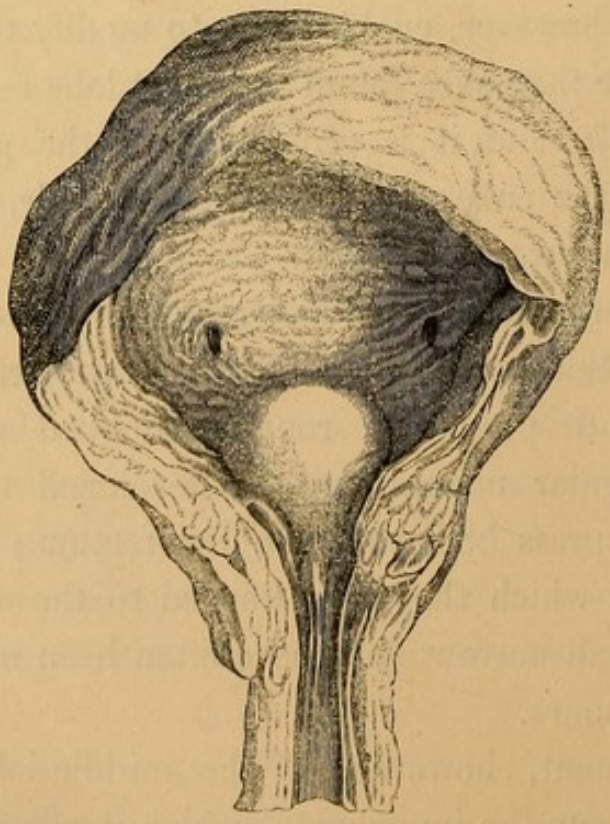
Sir Everard Home observed that the left lobe of the gland increases more rapidly and to a greater extent than the right one; and hence that the urethra will commonly be found to deviate to the right side. Subsequent experience, however, enabled him to modify this opinion. I have more than once found the right lobe more affected than the left, and it is probable that the greater prevalence of the enlargement on the left side, noticed by Sir E. Home, was accidental.

The enlargement may be irregular, and confined to certain portions of the gland which project above its surface, and present a rough, knobbed appearance. These irregular masses may be developed towards the bladder or press backwards on the rectum; and when the base by which they are attached to the body of the gland is at all narrow they have often been mistaken for fibrous tumours.

Enlargement, however, of the middle lobe is most important from the impediment which it offers to the dis-



ENLARGEMENT OF THE LATERAL LOBES WITH INCIPIENT INCREASE IN SIZE OF MIDDLE LOBE—A BAR OR RIDGE IS FORMED AT THE NECK OF THE BLADDER THROUGH WHICH A FALSE PASSAGE HAS BEEN MADE.



ENLARGEMENT OF MIDDLE LOBE.

charge of urine. Commencing in the form of a nipple, under the mucous membrane, which is pushed before it so as to be put on the stretch, it encroaches upon the vesical cavity in the direction from the urethra to the verumontanum. In its further increase, observes Sir E. Home, it loses the nipple-like appearance, becoming broader from side to side, and forms a transverse fold by pushing forward the membrane connecting it to the lateral lobes, which also become proportionally extended.

It presents, says Rokitansky, the appearance of a rounded tumour, of the size of a bean or hazel nut, which projects into the neck of the bladder: it may increase to the size of a walnut, hen's or duck's egg, or more; and then protrude into the cavity of the bladder in the shape of a smooth or rough, nodulated, slightly lobular, rounded or cordiform, pyramidal, or cylindrical tumour.

Considerable enlargement of the prostate gland cannot take place without affecting the condition of the urethra and bladder in a more or less remarkable manner. Hypertrophy of a single lobe will cause the canal of the urethra to deviate to the opposite side; general enlargement compresses the canal laterally, and often reduces it to a mere slit. In some cases, however, the prostatic portion of the urethra has been dilated into a kind of sinus, capable of containing some ounces of urine.

Enlargement of the middle lobe may produce an apparent splitting of the urethra at the neck of the bladder; or the neck of the organ may be compressed and narrowed. When carried to any great degree it gives rise to many important changes in the condition

of the urethra and bladder. It elongates the prostatic portion of the urethra, and sometimes in such a manner that the surgeon bas been unable to pass an ordinary sound through the neck of the bladder. It throws up this latter part towards the pubes, and causes a great obstacle to the introduction of instruments. It increases the depth of the perinæum, and presents an obstacle to the performance of lithotomy; it deepens the floor of the bladder, on which the calculus rests, and often renders lithotrity impossible.

But the great inconvenience arising from hypertrophy of the middle lobe is the impediment which it offers to the due evacuation of the bladder.

As the tumour and the transverse fold, already noticed, are situated immediately behind the internal orifice of the urethra, they are pushed before the urine in every attempt that is made to void it, acting like a valve and closing the opening till the cavity of the bladder is very much distended; then the anterior part of the bladder being pushed forward, and the tumour drawn back, in consequence of the membrane of the posterior part of the bladder being put on the stretch, the valve is opened, so that a certain quantity of water is allowed to escape, but the bladder is not completely emptied. A very small enlargement, however, of the middle lobe, projecting into the bladder, with the transverse membranous fold connecting it to the lateral lobes, is sufficient to produce a complete retention of urine.

The prostatic ducts may be so enlarged as to contain a considerable quantity of fluid, and to present upon post-mortem examination several fluctuating prominences.

I remember to have seen, upon examining the bladder and its appendages of a man who died at an advanced age, of retention of urine, an enlargement of both lateral lobes of the prostate, and several cysts formed of dilated ducts which projected from either side of the generally hardened mass. There was no trace whatever of inflammatory disturbance; the tissues surrounding these structures were perfectly healthy, and separated readily when dissected from the neighbouring parts to which they were connected by loose cellular tissue. One of the cysts contained as much as half an ounce of fluid.

The morbid conditions of the bladder connected with hypertrophy of the prostate gland chiefly depend on the impediment offered to the free discharge of urine. In the early stages of the disease the accompanying derangement of the bladder appears to be merely functional; and to consist in an increase of irritability; and this is a principal cause of the great and frequent desire, and consequent straining, to make water, when there is only a very small quantity in the bladder. The irritation extends to the muscular coat, so that the bladder does not contain more than half the usual quantity of urine before strong efforts are made to empty it.

As the disease advances, and with it the difficulty of voiding the urine, sometimes amounting to complete retention, inflammation of the mucous coat of the bladder is apt to set in, and extend from the vicinity of the tumour to the other parts of the cavity. In severe cases this inflammation may terminate in ulceration

and destruction of the mucous tissue, or even in perforation of the bladder from sloughing.

Hypertrophy of the muscular tissue and a sacculated condition of the bladder are, as is well known, the frequent effects of any great impediment to the evacuation of the urine.

In cases of chronic enlargement of the prostate, I have often seen the longitudinal fibres of the bladder greatly hypertrophied, and of a red colour, passing in bundles over the thickened inner coat, but the cellular tissue connecting them has always, in complicated cases, been loose and free, which would not be the case in a part previously the seat of inflammation.

The sacculated or encysted state of the bladder I have fully described in my work on lithotrity and lithotomy, and in another part of this volume. It results from the violent efforts to expel the urine, whereby the mucous coat is protruded through the hypertrophied fibres in the form of a pouch. This is an unfavorable complication, for the lining membrane of these sacs is very liable to take on suppurative inflammation, either from the sojourn of urine within their cavities, or, as Mr. Adams has ingeniously observed, from the mere circumstance of displacement. Dilatation or inflammation of the ureters, and secondary disease of the kidneys, frequently supervene during the last stages of chronic enlargement of the prostate. The effect of retention of urine as a mechanical obstacle is sufficiently obvious; in other cases the kidneys appear to suffer sympathetically. The capsule becomes firmly connected with the cortical substance by chronic

inflammation; the effusion of lymph blocks up and compresses the minute vessels in the secreting substance, and the whole organ eventually becomes smaller and and firmer than natural. The flow of urine, which, during the period of vascular excitement had been increased, is now much diminished, and albumen, with blood-discs, and other abnormal elements are found mixed with the proper renal secretion.

The irritation reflected from the hypertrophied prostate is apt to produce vascular excitement in the vesiculæ seminales, the walls of which become thickened and blended with the surrounding parts. Hence, patients are sometimes troubled with nocturnal emissions, from which even the aged are not always free.

I have not observed that the testicles suffer in these affections, although, upon several occasions I have noticed that hydrocele has existed in patients who have consulted me for prostatic disease.

A variety of causes have been assigned for hypertrophy of the prostate—excessive venery, strictures of the urethra, riding on horseback, gonorrhœa, irritation from vesical calculi, &c. Gonorrhœa is a disease common among the young, but uncommon in those of advanced years, in whom enlargement of the prostate is chiefly met with. That enlargement of the gland may also occur in persons who have led perfectly chaste lives is unquestionable. Strictures of the urethra are usually classed among the exciting causes of this affection. Sir Everard Home entertained this opinion, but in his account of the cases which came under his observation, he has not confirmed his statement. Civiale, on the other hand, declares that the prostate is usually healthy

in persons affected with permanent stricture; and Mercier thinks that so far from being a cause of hypertrophy of the organ, stricture of the urethra is calculated to produce atrophy.

In the opinion of many surgeons, hypertrophy of the prostate gland is connected with the declension of the generative powers which takes place after a certain period of life. I do not feel inclined to adopt the theory, that in a state of perfect health the prostate gland becomes enlarged with advancing years. On the contrary, I believe that if no morbid change is going on, the prostate, like other parts of the body, decreases in size. That the affection occurs chiefly amongst persons beyond fifty years of age, is undoubted; but the cause of this tendency has not yet been clearly ascertained.

The symptoms of incipient enlargement of the prostate gland are vague, and easily passed over by the patient. At first he experiences some uneasiness and occasional pain, though of a slight kind, in the region of the bladder. The uneasiness is dull, and the pain, when aggravated by any excess, may extend along the urethra and down the thighs, or to the back; but it is seldom so acute as to excite much attention. Up to this point the irritation may be considered as confined to the gland itself. As it enlarges, the irritation quickly extends to the bladder, the neck of which begins to resent the encroachment made on it by the gradually augmenting prostate. The patient is now sensible that his calls to make water are more frequent, and he perceives that the urine flows in a slower stream than natural. After some time the difficulty of ex-

pelling the urine becomes evident; its flow is irregular, and the last drops, especially, are not evacuated without considerable effort, and their passage is often accompanied by a painful sensation resembling scalding. During the early stage, this difficulty of evacuating the bladder varies much, even in the course of twenty-four hours; at one time the patient passes his water freely; in an hour or two he experiences great difficulty in making water, and endeavours to promote the discharge of the last drops by pressure along the urethra. He is now tormented by the idea that he labours under stricture, or he may attribute his sufferings to internal piles. The urine during this stage is clear, or slightly charged with mucus.

The greater part of the symptoms now mentioned may be regarded as physiological; but as soon as the gland has become enlarged to a certain size, symptoms, evidently dependent on a mechanical obstruction at the neck of the bladder set in. As the gland increases in volume, the part juts out into the bladder, and some of the urine is retained; the bladder is unable to expel the whole of its contents; when the patient has voided all he has in his power to do, several ounces may still be left behind. The desire to micturate now increases in frequency. The moment after urine has been passed the patient has an inclination to make more; the pain is more intense, and extends along the penis to the glans: the prostate is the seat of constant soreness, which may be throbbing or pulsative, hot to scalding, or even neuralgic in character. The urine becomes excessively fetid and alkaline, and emits a strong ammoniacal odour; it is also occasionally mixed with pus or blood. It is not

difficult to recognise a patient suffering from hypertrophy of the prostate when striving to pass his water; he bends the body forwards; his legs are straddling or wide apart; he strains with all his might, and uses every muscle to overcome the resistance to the flow of urine. During these efforts the fæces sometimes escape involuntarily, and prolapsus of the rectum may occur. The stream of urine is small; a quantity escapes after the patient supposes that the bladder is emptied, and the clothes become soaked, wet, and offensive. The general health soon begins to fail; the tongue is loaded, there is little appetite, the feet are cold, the skin dry, and the bowels irregular. His sleep is broken, for he suffers more at night; he is obliged to rise every quarter or half hour to relieve his bladder. Exposure to atmospheric influences aggravate all these symptoms; he becomes at last haggard, thin, weak, and almost worn out from the irritation, pain, and watchfulness.

The symptoms, therefore, of incipient enlargement of the prostate are irritability of the bladder, combined with difficulty in expelling the urine, which flows in a slower stream than natural. But when the prostate is once considerably enlarged, the patient is always subject to sudden aggravation of his symptoms, amounting to complete retention upon exposure to cold or indulgence in any excess.

These symptoms are all increased by much standing or walking: rheumatic pains are felt down the thigh and leg, and likewise in the loins; occasionally there is hæmorrhage from the urethra; constipation, dyspepsia, headache, and frequently some scaly eruption on the skin exist.

Owing to the prostate being intimately connected with the neck of the bladder, every increase in the size of the former must affect the latter, causing some alteration in the exercise of its functions. The loss of power to empty the bladder is apparently the first effect thus produced, and its consequences are very serious. If, after the patient has exerted himself to empty the bladder, an ounce or two of urine are left in it, the desire to micturate soon returns.

Sometimes these symptoms occur suddenly. The patient awakes with a strong desire to void urine; he finds that he can scarcely pass any; and, on inquiry, it is discovered that exposure to cold or wet, or irregularity in diet or exercise, had previously occurred. The mucous follicles increase in size, and the surrounding cellular tissue becomes thickened, till, at last, the prostate becomes considerably enlarged, and the desire to pass water, as well as the difficulty in voiding it, increase proportionably to the size of the gland.

As the symptoms of hypertrophy of the prostate chiefly depend on mechanical obstruction to the discharge of urine, it becomes necessary to distinguish them from those of other diseases in which the same obstruction may exist. These are stricture, urinary calculi, and tumours about the neck of the bladder.

The diagnostic signs of tumours have been described in another chapter. The obstacle arising from enlargement of the prostate has been frequently confounded with the impediment produced by organic stricture, and the numerous preparations contained in our museums prove the unfortunate result of such a mistake.

It should be remembered that stricture generally occurs at an earlier period of life than hypertrophy of the prostate. The seat of the obstacle is often much nearer the external orifice of the urethra. When it occurs further back, the impediment to the discharge of urine being nearly the same in both cases, may lead to some obscurity, but a careful examination with the sound and through the rectum, will commonly enable us to detect enlargement of the prostate in one case and absence of it in the other.

Hypertrophy of the prostate produces symptoms which may by possibility be mistaken for those of stone in the bladder. In the latter affection, however, the flow of urine is suddenly stopped at any period by the calculus falling across the orifice of the urethra; while in the former, the stream of urine having once commenced to flow, continues until the evacuating effort ceases. Again, the pain and uneasiness about the neck of the bladder, in cases of enlarged prostate, are not aggravated when the urine has been drawn off by the catheter; whereas in stone these symptoms are usually more severe.

The fæces are often flattened when the prostate is sufficiently enlarged to press upon the rectum; the same, however, may be remarked when the canal of the gut is from any cause contracted. But no satisfactory opinion or correct diagnosis can be formed without careful examination of the prostate per anum; and the enlarged gland here lies so completely within the reach of the finger, that its size, form, and density can be sufficiently estimated in the greater number of cases. For this purpose the patient may be placed on his

back with the thighs bent and widely separated; or he may support himself upon his knees and elbows. The bowel having been previously emptied by an enema, the surgeon introduces the index finger, well oiled, and runs it upwards along the mesian line, and then directs it from side to side. A space measuring about three inches longitudinally may thus be accurately examined, and enlargement of the prostate always detected. It is also requisite to employ the long catheter, that deviations in the course of the urethra or changes about the neck of the bladder may be detected.

It is at all times a difficult task to attempt the removal of changes which occur in advanced life; and it must be confessed that we possess no certain means of diminishing the size of an hypertrophied prostate. The morbid change, once established, goes on until it interferes, more or less, with the expulsion of the urine, when surgical interference becomes indispensably necessary. Still these ultimate stages of enlargement may be retarded, and urgent symptoms may be so far prevented, that the patient may pass the remainder of his days in comparative comfort, under suitable treatment. He can by degrees learn what habits to pursue, what diet to adopt; and may acquire practical experience in the selection of suitable medicines to act upon the alimentary canal. He should repose as much as convenient in the horizontal posture; avoid taking exercise upon horseback; abroad he should prefer carriage conveyance; and his walks upon foot should not be of a length to excite fatigue.

The treatment must be directed to the enlarged

state of the gland itself and to any complication which may attend the hypertrophy. In the parenchymatous form the remedies will be chiefly addressed to the chronic inflammation which accompanies and is supposed to originate this variety. Local depletion, by the application of leeches to the perinæum, should be had recourse to, and the patient be kept at rest; in fact, the treatment already pointed out for inflammatory affections of the prostate must be employed, due attention being paid to the general condition of the patient. In some cases, where the inflammatory symptoms become more active, blood may be taken by venesection, if the patient be strong and of full habit. In general, however, the subjects of this affection are not suited either by years or constitutional powers to bear general depletion. The bowels should be relieved of all accumulation; not by drastic purgatives, such as aloes or colocynth, but by the confection of senna, castor oil, supertartrate of potash, or sulphur. An occasional dose of blue pill, or of calomel, may be administered with advantage. I am a great advocate for the use of enemata. There seems to me no good reason for disturbing the whole length of the alimentary canal by purgative medicines administered by the mouth, when the end to be desired can be obtained by injecting a pint of warm water or thin gruel with salt into the rectum.

The food should be simple, plain, and nutritious. Wine, brandy, and other stimulating drinks should be avoided. Iodine has been strongly recommended, either given internally, or applied in the form of ointment to the enlarged structure. It may be ordered in the

form of iodide of potassium, three grains three times a day, in water, sarsaparilla, or some other vehicle. No speedy change can be expected, the medicine requiring a considerable time to effect any important diminution in the gland. Indeed a patient may consider himself fortunate if iodine possess the power of controlling further enlargement; he then, at least, knows the extent of his ailments.

I believe cicuta may prove beneficial in some cases. It has been tried to a considerable extent in this country, and with apparent advantage. I usually give it in the form of extract, and frequently combine it with iodide of potassium.

Mercury is not a remedy to be employed here. We might as well attempt the dispersion of an enlarged thyroid gland by salivation, as the diminution of an hypertrophied prostate. The state of tender gums, disturbed appetite, morbid secretions, and irritable bowels, inseparably connected with the effective administration of this powerful mineral, is not one of indifference to the patient. We render him very uncomfortable, and he is but ill-disposed to submit to such a state, unless with the anticipation of some decided benefit. This we cannot ensure him.

Counter-irritation is sometimes advantageous; but it was more employed when hypertrophy of the prostate was considered to be an inflammatory affection.

Suppositories of opium or hemlock, as recommended long ago by Sir Everard Home, relieve irritation; and may lessen congestion of the organ consequent upon it. The warm bath, and warm fomentations, are useful for the same purpose.

Great care should be taken that the bladder be emptied at stated intervals. About four times a day, when the weather is mild and the atmosphere clear, will suffice for the relief of the organ. If the bladder be constantly called upon to expel its contents it becomes morbidly irritable, and the muscular coat is unduly thickened. If the urine be allowed to accumulate, the bladder loses its expulsive power entirely. The catheter is then required, and the patient will probably be compelled to use it the remainder of his life.

Hæmorrhage from the prostate, whether arising from ulceration, from the accidental rupture of vessels, or from injury by the catheter, may be treated by opium and gallic acid, or the subacetate of lead with opium, in doses of from one to two grains of the former to one of the latter, every six hours, or by the infusion of roses with sulphuric acid and sulphate of alumen. In plethoric patients, or those subject to active hæmorrhage, such remedies should be preceded by general and local bleeding, injections of cold or iced water, &c. The catheter, should, if possible, be avoided during hæmorrhage; or, if irritation and useless efforts to void urine render it necessary, it should be allowed to remain, in order to keep the parts at rest. The bladder, if filled by coagula, should be washed out.

The great relief which we can afford our patient is by the judicious use of the catheter; this must be two inches longer than the ordinary one; it may be either elastic, or of metal, the curve in the latter being sharper than in the ordinary instrument, that it may the more readily pass over the obstructions at the neck of

the bladder. With such an instrument it is rare that a careful surgeon fails in overcoming the class of obstructions which I have now been attempting to describe.

A winding passage is, sometimes, formed through the prostate, by alterations in the shape of its canal; the channel being thrown to one side, frequently to the right — a circumstance to be recollected on passing the catheter, when obstruction is felt at the neck of the bladder. It obviously is one of the cases in which an elastic catheter will pass easily without a stilet, though with difficulty, or not at all, when the stilet is retained.

The catheter should either be passed every six or eight hours as the irritation returns, or it should be left in the bladder. In the latter case, after the first two or three days, it is generally recommended to withdraw it, and repass it occasionally. If, however, it cannot be easily introduced, it will be better to secure it in the bladder, allowing the water to flow through it at intervals.

Sir E. Home says, that "wherever any degree of difficulty has occurred in passing the instrument the first time, it is always prudent to retain it in the bladder; for unless it is introduced again in five or six hours, its having been introduced at all is of little use; for in that period the bladder is generally as full as it was when the water was drawn off. Whether this arises from the accumulated fluid in the kidneys passing into the bladder, or from the pressure taken off from the mamillary eminences, making them secrete more freely, is imma-

terial; but the fact is of importance, since it makes it necessary again to empty the bladder, and the disturbance the parts received in the first operation, cannot so soon have gone off, and, therefore, must increase the difficulty in the second attempt."

The usual mode of securing the catheter, is to apply a common T bandage, of which the longitudinal band is divided, up the middle, into two portions, one of which lies in each angle between the scrotum and thigh, and to which the catheter may be secured by ligatures.

The following method has been found successful in difficult cases: namely, to pass a gum catheter as far as possible without a stilet, and this will probably be to the enlargement of the prostate; then to introduce a stilet into the catheter, without withdrawing the latter from the urethra; and, finally, to employ the stilet to direct the point over the tumour of the prostate.

Mr. Hey pointed out another method of using the catheter, which has now and then succeeded. The catheter is to be passed with the stilet to the enlarged prostate — then the stilet is to be partially withdrawn, a manœuvre which tilts up the end of the catheter, and may enable it to ride over the protuberant gland.

When the parts are irritable, Dr. Gideon Mantell suggests that the catheter should be smeared with an ointment composed of five grains of acetate of morphium, and an ounce of spermaceti ointment; and relates an extremely interesting case of a large and inflamed

prostate, in which this unctuous application was of great service.

When the entrance of the catheter into the bladder is prevented by the existence of a bar or valve, the obstacle may often be overcome by using a long catheter with a very sharp curve, and depressing the handle of the instrument as soon as its point is felt to have reached the bar.

In selecting the kind of instrument to be employed, the surgeon will be guided by the circumstances of each case. The obstruction may arise from considerable development of the third lobe; or from enlargement of the lateral lobes, whereby the canal of the urethra is contracted laterally. These two kinds of cases obviously require different kinds of instruments.

For cases depending on enlargement of the middle lobe, I have constructed a prostatic catheter, with a long body and a short abrupt curve, which can often be introduced when the ordinary prostatic catheter fails.

Hitherto we have been going on the supposition that, though there be an obstruction to the evacuation of the urine, it is to be surmounted by appropriate remedies and the employment of the catheter. But it happens at times, not merely in this disease, but in other affections both of the bladder and urethra, that all our endeavours to relieve the distended bladder fail; and, in order to save the patient's life, our sole remaining resource is that of puncturing this viscus, and thus drawing off the urine. The spots usually selected for this operation, are either above the pubes or through the rectum.

The puncture above the pubes can be effected by a previous simple division of the skin, and separation of the recti and pyramidales muscles. A straight, long trocar is then to be used, for the purpose of perforating the bladder; care being taken to retain the canula, and, by the position of the patient, to guard against infiltration. This mode of puncturing the bladder was formerly preferred in cases of enlargement of the prostate.

The puncture from the rectum can be performed without injuring any important parts. A curved trocar in a canula is to be passed along the finger of the left hand to the triangular space, bounded by the vesiculæ seminales and peritoneum; it is then pushed forwards into the floor of the bladder. The instrument is then withdrawn, and the canula retained for a certain time, until the cause for the proceeding is got rid of. I have performed this operation several times, without the least difficulty, and it is the one which I prefer.

Mr. S. Cooper* never saw a case in which retention of urine from chronic enlargement of the prostate gland terminated in extravasation of urine from rupture of the bladder. Sir Astley Cooper met with but one instance of this accident; and the reason of its rarity is given by Desault, who remarked, long ago, that in every case of retention, where the urethra is free from obstruction, the urine, after distending the bladder to a certain point, generally dribbles away through that canal, and the patient may live a good

* Surgical Dictionary, p. 110.

while in this condition. But when the retention depends upon any stoppage in the urethra, the urine then does not partially escape; the distension increases, and if relief be not speedily afforded, the urethra gives way behind the stricture or obstruction.

CHAPTER XXVII.

TUMOURS OF THE PROSTATE GLAND.

The prostate, like other parts of the body, may be the seat of tumour; and if we follow the divisions generally adopted by pathologists, we may state that the tumours found in the prostate are scrofulous, fungoid, cancerous or fibrous growths. Scrofulous deposit occasionally takes place in the substance of the prostate gland, in the same manner and under the same circumstances, as in other tissues. It is never found in the prostate alone; but always co-exists in the lungs, and generally in other organs; the testes and vesiculæ siminales often participate in the complaint.

The tubercular matter may be collected into a mass, forming a solid tubercle, or it may be disseminated in the substance of the gland; this latter is, I believe, the more frequent form.

This morbid deposit of yellow colour, deeper than that seen in the lungs, is infiltrated through the substance of the gland, in larger or smaller masses, which soon become confluent and softened. Ulceration then ensues, and the whole interior becomes excavated into an irregular cavity, bounded by the prostatic capsule, and

containing a mixture of tubercle and pus. Unless the contents be speedily evacuated by puncture from the perinæum, there is great danger of the abscess bursting into the urethra or rectum; and even under favorable circumstances it not uncommonly happens that this communication takes place from the encroachment and subsequent softening of the tuberculous masses upon the parts bounding the purulent collection. Under such circumstances the verumontanum and seminal ducts are destroyed.

In the vesiculæ seminales, the tuberculous matter is deposited in a continuous layer, which produces ulceration of the mucous membrane. Shreds of ulcerated tissue, infiltrated with tuberculous matter and floating in pus, are often found within their convoluted tubes. The disorganization may extend through their coats, and cause perforation of the bladder, when the contents of this latter organ will escape into the cavity of the abdomen, and cause death by peritonitis.

I have remarked that tuberculous deposit in the kidneys is in these cases frequently present. Small masses in the cortical substance, gradually increasing in size, become confluent and softened, as in the prostate, and an irregular cavity is formed containing a mixture of pus and tubercle. If the patient live long enough this abscess may burst internally; but it is generally combined with extensive disorganization of other important organs.

The symptoms of tubercular disease of the prostate are extremely obscure, and a diagnosis can only be formed from the general condition of the patient. So long as the tubercular matter is small in quantity and concrete,

the patient experiences no inconvenience; the change gives rise to no symptoms, and therefore cannot be detected. The earliest signs are those of chronic enlargement of the gland, which proceeds gradually and with little or no pain. When the enlargement has proceeded to such a degree as to excite any irritability of the bladder, or oppose any impediment to the free discharge of the urine, it may be detected by the finger introduced into the anus; but then will arise the question, what is the nature of the tumour or enlargement with which we have to deal? This cannot be determined with certainty at an early stage; but there will be strong reason to suspect its scrofulous origin, when the tumour has been of slow formation, and unattended with pain; when the patient is young and presents signs of the scrofulous diathesis.

The treatment, in cases of this kind, must be mainly directed to that state of the constitution under which the tubercular deposit takes place. Local remedies will be of little or no avail. When abscess forms, it must be treated in the ordinary manner.

In my own practice I have never met with a case of scirrhus of the prostate. We know how hard an organ may become when there is a small addition to its size by the deposit of a material sufficient to distend, but not to weaken the fibrous capsule around it. I have examined a testicle of stony hardness, which might have been pronounced a well-marked instance of scirrhus. Upon dividing the gland, after it was removed, I have found within the tunica albuginea a quantity of soft, perhaps semi-fluid, medullary cancer. Until, therefore, we can verify our

conclusions by dissection, some doubt must remain as to the exact nature of these indurations of the prostate. "The so-called scirrhus of the prostate," says Civiale, "of which so much is spoken by Baillie, Desault, Chopart, and others, is nothing more than considerable induration of the gland, the tissue of which sometimes acquires sufficient consistence *pour crier sous le scalpel.*" As to cancer, properly so called, it is so rare that Prout and Cruveilhier affirmed they had never met with it.

Cancer in any shape, observes Rokitansky, rarely occurs in the prostate, which is curious, as contrasted with the frequency of its occurrence in the uterus. Medullary carcinoma is occasionally found to attack the prostate, and to give rise to considerable enlargement of the gland; it may sometimes perforate the fundus vesicæ, and sprout into its cavity, causing a cancerous ulcer, with raised edges and varying size. My own experience agrees with these opinions. I have met with cases of medullary cancer, but not of true scirrhus.

Some examples, however, have been recorded by Mr. Travers,* Mr. Howship,† Mr. Adams,‡ Mr. Cock,§ Mr. Haynes Walton,‖ and a few other surgeons.

The prostate is not much enlarged in cases of true scirrhus. In the cases recorded, the scirrhous mass either projected from one of the lobes into the cavity of

* Med.-Chirurg. Trans., vol. xvii.

† Ibid., vol. xix.

‡ The Anatomy and Diseases of the Prostate Gland. Longman and Co., London, 1851, p. 132.

§ L. c., p. 136.

‖ Transact. of Path. Society, vol. i, p. 287.

the bladder, or was contained as a nodulated tumour in the interior of the gland. In Mr. Howship's case the whole gland is described as having been converted into a substance perfectly resembling cartilage.

Encephaloid cancer of the prostate has been met with much more frequently than scirrhus. Cases are described by Mr. Langstaff, Mr. Howship,* Mr. Stafford,† Mr. Solly,‡ Mr. Thomson,§ Mr. Mercier,‖ M. Civiale,¶ Mr. Fergusson,** Dr. Gross,†† and by Mr. Moore.‡‡

Encephaloid cancer is the form which the disease commonly assumes in children, and many of the subjects were of tender years.

It is often accompanied by similar growths in other parts of the body. In some cases, the whole gland is completely transformed into medullary matter; in others, the malignant growth is confined to a single lobe, often the middle one. It more rarely happens that the tumour springs from the surface of the prostate and projects into the bladder. The tumour does not commonly attain a large size, although, in Mr. Langstaff's case, it is described as large as an orange. In Mr. Solly's case the enlarged prostate contained medullary matter, which had not yet commenced to soften.

The symptoms of cancer of the prostate, as such,

* Medico-Chir. Trans., vol. xix.
† L. c., vol. xxii, p. 218.
‡ Transact. of Path. Society, 1850-51, p. 449.
§ L. c., vol. v, p. 206.
‖ Mal. des voies ur., p. 169.
¶ Traité Pratique, vol. ii, p. 446.
** Lancet, vol. ii, p. 151, 1853.
†† L. c., p. 719.
‡‡ Med. Times, Aug. 14th, 1851, p. 174.

are often obscure, because they are likely, for some time at least, to be confounded with those of simple tumour or ordinary enlargement.

The tumour, according to its size, position, &c., will create more or less impediment to the discharge of urine, and will cause irritability of the bladder; but these symptoms may arise from a variety of causes. Some difference in the symptoms will also occur according as the tumour projects or not into the cavity of the bladder. For the present I suppose it confined to the gland. According to Mr. Adams, the irritability of the bladder is greater than under ordinary hypertrophy, and the evacuation of the organ is less impeded. The pain after micturition is, however, much more severe, and the urine is not unfrequently tinged with blood.

As the disease advances, the pain in the perinæum and about the neck of the bladder often becomes excruciating.

The local symptoms are not always more characteristic than the general. On examining the prostate through the rectum it is easy to detect enlargement, or perhaps discover the presence of a tumour, but the nature of the enlargement has still to be made out.

In cases of scirrhous prostate, the excessive hardness and nodulated feel of the tumour may assist us, when joined to other signs, in forming a diagnosis, yet it must be remembered that the gland often contains calculous concretions. Doubt must always exist, unless in addition to the local signs there are other symptoms which indicate the existence of a cancerous affection.

Thus, malignant tumours may be developed in other parts of the body, or the patient may have the appearance of labouring under malignant disease. Under such circumstances, if a tumour be discovered in the prostate, giving rise to pain and a highly irritable state of the bladder, its cancerous nature may be reasonably predicted.

The urine should be examined in all suspicious cases; cancerous cells may, perhaps, be detected in it; but we cannot expect this to occur so long as the tumour is entirely confined to the gland. I am aware of one case only in which cancer-cells were found, and there the discovery was made too late.

The following cases illustrate some of the features presented by malignant disease of the prostate gland.

Mr. Stafford has related a case in a child only five years of age. The gland was equal in size to the largest walnut, its form was somewhat globular, as is often the case with the enlarged prostate in advanced life. There advanced from the prostate into the bladder, immediately behind the orifice of the urethra, a rounded nipple-like projection, nearly equal in size to a small hazel nut, and exactly resembling, both in its appearance and situation, the projection of the gland usually ascribed to an enlargement of its third lobe. On making an incision through one lateral lobe of the prostate, the cut surface exhibited none of the natural texture of the gland; it was decidedly encephaloid in colour, consistence, and texture, and one part of the cut surface exhibited so dark a colour as to present the appearance of there being melanotic deposit mixed with the encephaloid matter.

It may be necessary to observe that the prostate gland, in a child of five years of age, is about the size of a small hazel nut; consequently its increase of volume, in this case, was great; and even its third lobe alone was as large as the normal size of the whole gland itself at that period of life.

The bladder was contracted to about the size of a turkey's egg, and found to contain about an ounce of urine mingled with purulent matter. The mucous membrane of the bladder was somewhat thickened; in other respects this organ was sound.

Mr. Solly relates a similar case in a child three years old, in whom the prostate was the size of a hen's egg. The tumour presented a cream colour on section, and a lobulated condition, with a fibrous tissue surrounding the lobules, giving it a gristly feel. It was of the same nature as the one described by Mr. Stafford, and contained innumerable cells.

Mr. Moore, of the Middlesex Hospital, has recorded a remarkable case of prostatic cancer, attended with peculiar circumstances.* The patient, a man aged 53, was admitted into the Middlesex Hospital, with a large pulsating tumour in the left groin. The tumour lay precisely in the situation of the external iliac artery, and resembled an aneurism, but was partly lobulated. It was considered to be aneurismal, and the common iliac artery was tied.

The patient survived the operation forty-three hours, and died of peritonitis. The tumour was the largest of several masses of enlarged glands affected with

* Medical Times, Aug. 14th, 1851, p. 174.

encephaloid cancer. It lay against the ilium, and was enclosed in thick fascia, which had given way at the soft prominences felt during life. It was somewhat tightly girt in almost a circle of arteries, the external iliac being stretched and flattened along its upper surface and beneath the fascia, the internal iliac lying in contact with its posterior part, and the obdurator artery beneath it completed the circle, except where the tumour and pubes intervened between it and the external iliac trunk. Moreover, the large branches of the internal iliac passed through the tumour. There were small secondary cancerous depositions in the kidneys, and an encephaloid growth sprang from the back of the prostate gland (which was otherwise healthy,) and extended upwards between the bladder and rectum. This appeared to be the primary growth. Some urine, pressed out through the urethra after death, was examined by the microscope, and was found copiously pervaded with cancer-cells. That which had been observed during life, being clear, was not examined microscopically.

Mr. Haynes Walton has also related an interesting case of scirrhus of the prostate, attended by peculiar circumstances.

The patient, a gentleman aged 59, had enjoyed good health, when he was suddenly seized with feverishness, pains in the loins, and difficult micturition.

These symptoms were soon followed by pain in the right lumbar region, constipation, tenesmus, pain in the rectum just before making water, and shooting pains on the inside of the thighs and along the urethra to the glans, while water was being passed. This state con-

tinued, with intervals of ease, for six months, when he came under Mr. Walton's care. A slight enlargement of the prostate was now detected; the urethra was found somewhat pushed forwards by an apparent enlargement of the third lobe. The catheter was passed, and the urine was drawn off, at first, five or six times daily, then two or three times.

About a month after Mr. Walton's first visit, the desire to pass water became most urgent, and on introducing the finger into the rectum, the prostate was found to be greatly enlarged; there was constant and severe pain at the neck of the bladder. Soon afterwards the patient was obliged to keep his bed, and the prostate became so enlarged that it was impossible to introduce the finger between it and the sacrum. The patient now gradually sank, and died comatose, about six weeks after Mr. Walton's first visit.

After death the true pelvis was found filled by a tumour, which proved to be the prostate gland converted into a scirrhous tumour. No trace of its natural tissue remained. On the anterior part of the diseased mass was a cavity with irregularly ulcerated walls, containing unhealthy pus; there was no trace of urethra, but the bladder opened directly into it. The pelvic lymphatic glands on the right side, were carcinomatous.*

Other cases, besides the above, illustrate the fact that malignant disease of the prostate may exist without giving rise to any characteristic symptoms. This is more likely to occur when the medullary matter is infiltrated

* Trans. of Path. Society, vol. i, p. 287.

through the substance of the gland, as in the following example.

The patient, a man sixty years of age, had been under the care of Mr. Henry Thompson for frequent and difficult micturition, evidently arising from enlarged prostate gland. His symptoms were much relieved by medicine and the use of the prostatic catheter. He continued in this state for two years, suffering occasionally from retention of urine, but otherwise experiencing little pain or inconvenience. After the lapse of two years he was attacked by paraplegia, for which he was admitted into the Marylebone Infirmary, on the 9th of December, 1853. At first he seemed to improve slightly, but early in February, 1854, the urine was passed with increased frequency, became bloody, and contained much phosphatic deposit. He died on the 23d of the same month, in a state of great emaciation.

The prostate was found enlarged to the size of a small orange, being nearly equally increased in all directions. On dividing the right lobe, its structure was found softened, and of a pink colour, from congestion; the fibres of the prostatic tissue were seen to be separated from each other by soft, almost creamy matter, infiltrated amongst them. The juice, when mixed with water and placed under the microscope, exhibited cancer-cells. Cancerous matter was also found adherent to the dura mater of the chord, and in a lymphatic gland near the bladder. Beneath the mucous membrane of the neck of the bladder were five or six small masses, varying in size from a pea to

a horse-bean, and firmly fixed to the muscular coat, but unconnected with each other or the prostate. These small tumours likewise contained cancer-cells.*

The prostate gland sometimes contains tumours of a fibrous nature, which may be also out-growths from it. In many cases it is difficult to distinguish these tumours from the true prostatic tissue; they appear to be nothing but hypertrophied portions of the gland. In other cases, however, they are separable from the tissues of the prostate, or differ from them in structure. They may be developed, it would appear, in any part of the gland, or project from its posterior lobe into the cavity of the bladder. These tumours, as Mr. Thompson observes, are probably formed from the whitish fibrous-looking tissue, which intervenes in the natural state between masses of the gland-structure, almost surrounding and isolating them. In several cases these have been found to be made up of the same elements as this fibrous tissue, and are more distinctly connected with it than with the glandular parts. The fibrous tumours, moreover, are not found to contain the concretions so often present in the prostatic tissue, and their isolation is shown by the possibility of sometimes enucleating them without lacerating the surrounding parts.

There are no symptoms by which tumours of this kind can be distinguished from hypertrophy of the prostate, with some degree of which they are usually associated.

* Trans. of Path. Soc., vol. v, p. 205.

The treatment of malignant disease of the prostate is, of course, merely palliative. The pain and irritability must be relieved by full doses of opium, while retention of urine is obviated by a cautious use of the catheter.

CHAPTER XXVIII.

PROSTATIC CONCRETIONS.

The calculi so often found in the prostate gland, although not properly ranked with urinary calculi, must not be passed without notice. These calculi are composed of phosphate, with a little carbonate, of lime and animal matter. They are found in the cells of the prostate, are usually small, and often rounded and numerous, but become irregular as they increase in size. Larger calculi, sometimes of considerable bulk, are occasionally found in abscesses and cysts in the prostate; these are smooth and sometimes highly polished, resembling porcelain in appearance. They are sometimes laminated with radiating striæ, at others compact. Occasionally they consist of the neutral phosphate, but far more frequently of the bone-phosphate. These calculi may be analysed by dissolving them in hydrochloric acid, and adding liquid ammonia, until all the phosphate of lime is precipitated, filtering and precipitating the remainder of the lime which existed as carbonate, by oxalate of ammonia.

The distinct calculi of the prostate gland are to be

distinguished from the minute concretions which form in its follicles. The first have been long known, and have been described by many pathologists. The latter have been only of late brought under the notice of pathologists, and their microscopic appearances have been described by my colleague Dr. H. Jones, and Mr. Quekett. These concretions occur in minute follicles of the gland, and the average diameter of the follicles does not, as it appears, exceed the hundredth part of an inch. The colour of these minute bodies is deep yellow or red; sometimes, however, they are pale and colourless. Being so very minute, they are hardly distinguishable from the texture in which they are deposited. Dr. Handfield Jones thus describes their mode of formation: "They arise in a large oval vesicle of a single wall of homogeneous membrane. This is occupied by a colourless finely mottled substance, in the centre of which a nuclear corpuscle sometimes occurs. Their mean diameter is about $\frac{1}{1000}$th of an inch. In those of larger size the envelope is still seen, but the contained amorphous matter is beginning to be arranged in layers concentric to the envelope. In the further stage the vesicle measures $\frac{1}{200}$th of an inch or or more, showing concentric layers which are more developed on one side than on another, like so many repetitions of the original envelope, the intervals between the layers being occupied by a finely mottled deep yellow or red substance. There is a central cavity corresponding with the external contour in its form, which is triangular, with rounded angles or quadrilateral. From this normal appearance these bodies present numerous variations in form and internal arrangement,

and appear to occupy an intermediate position between organic growths and inorganic concretions; to the former by their vesicular origin and by their growth, which chiefly appears to take place by the dilatation of the vesicle and successive deposits in its interior; to the latter by their shape, their tendency to become infiltrated with earthy matter, and to pass into the condition of a dead amorphous mass of a deep yellow, red, or even almost black. The chemical composition varies probably with their different stages of development, at first consisting of little else but animal matter, then acquiring, especially when in a state of degeneration, calcareous salts, stated by Dr. Prout to be phosphate with a little carbonate of lime. The colouring matter is unaffected by ether, liquor potassæ, and muriatic acid."*

According to Mr. Quekett, these concretions are met with so frequently that they might seem to be a part of the constituents of the gland or its secretion. From his account it appears that the concretions commence by a deposit of earthy matter in the secreting cells of the gland; that they increase in size either by aggregation or by deposition in the form of concentric layers, and thus in the former case that they take the moulds of the follicles, and in the latter that they exhibit on section the usual appearance of an uric acid calculus. Mr. Quekett says that the parietes of the adjacent cells in which a deposition has taken place are in contact and may be destroyed, so that on the addition of dilute muriatic acid by which the earthy matter is dissolved a many-celled

* Medical Gazette, August 20th, 1847.

cavity is left. Owing to the peculiar mode in which they mould themselves to the follicles, they not unfrequently present on the external surface an appearance resembling that of mulberry calculus. Mr. John Adams, in his able work on the 'Prostate Gland,' remarks, that the opinion of Prout as to the deposition of earthy salts being the result of a deranged action in the mucous membrane is thus fully borne out. "I have examined," he says, "these concretions, with Mr. Quekett, in a prostate removed from a young man who had died of phthisis; they were exceedingly numerous, especially in the middle lobe. The middle lobe was much larger than either lateral lobe."

Prostatic calculi appear to be connected in their origin with these minute concretions. For if the latter do not undergo solution, and become removed, they can hardly fail to become the nuclei of distinct calculi. If this view be adopted, a complete explanation is supplied of the immense number of calculi met with together in the prostate gland. The calculi of the prostate are usually round and firm, somewhat transparent, having a pearly aspect so as in some measure to resemble grains of pearl barley. They have a brown coating, which they seem to derive from the secretion of the gland. They gradually increase in size, and coming into contact with each other in the adjacent follicles, undergo a kind of articulation; their smoothness is so great that they put on the appearance of porcelain. In the progress of their development they cause absorption of the gland, so that it, or a part of it, is at such time reduced to a sac, often composed of many cells, containing 50 or 60 calculi. When the prostate gland has passed into this state,

it is felt through the rectum as if it were a bag full of marbles. At other times, a single cavity is found in one lobe, containing one large calculus. The smaller stones often escape through dilated ducts into the urethra, and may be extracted by the urethral forceps. The section of these calculi shows a radiated or laminated structure; in other cases the structure is compact.

The analysis of these concretions shows the presence of phosphoric acid and lime. Mr. Adams, in the work just quoted, regards the combination of these two substances in such calculi as reducible to two salts, namely, the neutral phosphate and the basic phosphate of lime. Those composed of the neutral phosphate are somewhat fusible before the blowpipe, and generally exhibit a crystalline structure; on the contrary, those composed of the basic phosphate are altogether infusible before the blowpipe. It should be remembered, however, that if the calculus under examination has passed into the bladder or urinary passages, it may have acquired a new coating on its surface. And thus when calculi formed in the prostate have passed into the bladder, that which was composed of basic phosphate of lime, and therefore wholly infusible may have become fusible by a coating of triple phosphate. It appears also that when exposed in the prostatic portion of the urethra, such calculi become coated with uric acid.

It is sometimes observed that the urine becomes milky from the great abundance of phosphates secreted in the prostate, and finally mingled with the urine. This milkiness is to be distinguished from that which might arise from a deposition of phosphates from the urine, and the diagnosis will chiefly consist in the symptoms of

irritation of the prostate gland and neck of the bladder, which cannot but accompany such a state of the prostatic secretion.

The symptoms produced by calculi in the prostate gland, will depend on their size, number, and situation. The prostate itself may be hypertrophied; if the calculi have attained any size, the tissue of the organ is absorbed, and it is converted into a number of sacs, in which the foreign bodies are lodged.

Very minute prostatic calculi give rise to no symptoms, and their presence is not suspected during life. When larger and projecting into the cavity of the urethra, they are generally attended with more or less irritation about the neck of the bladder. The patient complains of a sense of uneasiness in this region, and has frequent desire to void his urine; or some difficulty in passing the urine is often experienced. The pain and uneasiness are occasionally increased by violent exercise, as Mr. Wilson observes; but the same effect would result from stone in the bladder. In some cases these calculi excite acute inflammation of the gland, followed by abscess.

The general symptoms are seldom of a nature to determine, with any degree of certainty, the presence of calculi in the prostate; recourse must be had to examination, but even this is not always satisfactory. Unless the foreign bodies project into the urethra, or can be felt through the rectum, instrumental examination can be of little avail. In the former case, when a sound is introduced, the peculiar grating feel of the metallic instrument cannot be mistaken; but even here the calculus may be pushed into the cavity of the prostate, or into the bladder, during the first examination, and thus

escape subsequent researches. When numerous or large concretions have caused absorption of the tissue of the gland, they can often be detected by the finger introduced into the rectum.

The treatment is to be regulated according to the circumstances of each individual case. Unless the calculi produce some irritation they should not be meddled with. Should the symptoms be so urgent as to render an operation expedient, an attempt must be made to extract them by means of Weiss' forceps. This has often been done with success. When the calculi are too large to admit of being extracted whole, the urethral litholabe may be tried. M. Civiale has succeeded in detaching and crushing the calculi with this instrument in three cases. It has been recommended to push back the stone into the bladder; this proceeding would render an operation necessary at some subsequent period, and considering the ease with which a stone may be crushed, it is the best course which can be adopted.

When the calculi are so impacted as to elude the grasp of the forceps, while the patient's sufferings render an operation necessary, there is no resource left but to cut down on the foreign body through the perinæum, and remove it. However, if the calculus formed a considerable projection into the rectum, it may be questioned whether the recto-prostatic operation would not be preferable.

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