BRITISH MEDICAL JOURNAL:

BEING THE JOURNAL OF THE BRITISH MEDICAL ASSOCIATION.

EDITED BY DR. MARKHAM.

LONDON: SATURDAY, JANUARY 5, 1861.

A Lecture ON URINARY CALCULI.

BY

LIONEL BEALE, M.B., F.R.C.P., F.R.S.,

PHYSICIAN TO KING'S COLLEGE HOSPITAL; PROFESSOR OF PHYSIOLOGY AND OF GENERAL AND MORBID ANATOMY IN KING'S COLLEGE, LONDON; ETC.

General Consideration of the Subject. Animal Matter in Calculi. Of the Concentric Layers of Calculi. Of the Classes of Urinary Calculi, and of the Chemical Examination of Calculi. Tests kept in Small Bottles with Capillary Orifices. CLASS I. Calculi which leave only a Trace of fixed Residue after Exposure to a red Heat. Uric Acid Calculi; Chemical Characters. Calculi composed of Urates; Chemical Characters, Uric Oxide, Xanthic Oxide, Xanthine. Cystic Oxide or Cystine. Fibrinous Calculi. Fatty Concretions. CLASS II. Calculi which leave a considerable Quantity of Fixed Residue after Exposure to a red Heat. Oxalate of Lime Calculi; Chemical Characters; Calculi composed of Earthy Phosphate; Chemical Characters. Carbonate of Lime Calculi. Silicic Acid Calculi. Prostatic Calculi. Summary of Chemical Characters of Calculi. Of the Origin and Formation of Urinary Calculi, and of the Nature of the Nucleus. On the relative Frequency of the Occurrence of the different Calculi. On the Treatment of Calculous Disorders, and of the Importance of Detecting the Tendency to the Formation of Stone at an early Period. On dissolving Calculi in the Living Body.

GENTLEMEN,—We have now to consider some points in reference to urinary calculi. As there are several substances in healthy urine which possess but a slight degree of solubility, and as, in certain derangements of the physiological actions of the body, these compounds are formed in much larger proportion than in health, while other matters not present in healthy urine, and not readily soluble in water, are sometimes formed, you would readily infer that from time to time some of these matters would be slowly deposited in the insoluble form while the urine yet remained in the bladder, or before it reached this organ. It is very interesting to consider the nature of the various conditions which are likely to lead to the formation of calculi, and it is instructive to study the condition of the system in relation to the particular form of insoluble matter that may be deposited. If we were accurately acquainted with the mode of deposition of calculous matter, it is very possible that we might lay down such rules for the guidance of patients in whom this tendency existed as would prevent the formation of the stone, or retard its increase, if already formed. You must not always look for the cause of the deposition of a calculus in the characters of the urine; for it is possible that the urine may be healthy while a stone is forming, and that the changes taking place on the surface of the stone itself may cause the precipitation of insoluble substances. Remedies which act on the kidney in many cases exert no influence upon the formation of a stone. It is very important to study the chemistry of the body carefully;

and you will often find that the tendency to calculous disorder is not unfrequently explained by deranged chemical changes, which may perhaps be materially modified by attending to the action of the alimentary canal and skin, altering the mode of living, and administering the salts of the vegetable acids, alkalies, mineral acids, or mere diluents in large quantity, according to the nature of the case.

In those cases in which the deposition of the calculous matter mainly depends upon the state of the urine being unfavourable for holding certain slightly soluble matters in solution, it follows that the tendency to deposit may be averted, if the condition of the urine can be altered. It is possible that at one time an acid state of urine may favour the precipitation of uric acid; while, after a short interval, its characters may become so altered that it tends first to dissolve the uric acid, and then to precipitate phosphates, which are insoluble in an alkali. The latter salts are soon deposited on the uric acid, and protect it from the further solvent action of the alkali.

Animal Matter in Calculi. Calculi often consist of many different constituents; but usually one predominates greatly over the rest, and the calculus is named accordingly. Even the purest calculi composed of earthy salts contain, nevertheless, a certain quantity of organic matter; and those which seem to consist of organic material only, contain a certain proportion of earthy salts. A certain amount of animal matter is deposited with the hard material, and in many cases serves to agglutinate the particles together. After the hard matter of the stone has been dissolved, this animal matter may be seen in the form of a translucent, granular, mucus-like mass. Upon microscopical examination, sometimes the remains of delicate fungi can be detected in this matrix, and very frequently dumb-bells of oxalate of lime, or fragments of them, are found. The fungi were formed during the formation of the calculus; and it is possible that the reaction developed during their growth may have exerted an influence upon the precipitation of the insoluble matter.

The hard calculous matter may consist of substances which exist in healthy urine, like phosphates and uric acid, slowly deposited from their weak solution in the secretion; or of materials which are not present in perfectly normal urine, such as oxalate of lime, cystine, etc.

Of the Concentric Layers of Calculi. The insoluble material is deposited in distinct layers, which can often be readily detached and separately examined. These layers are easily demonstrated by making a section of the calculus, which can, except in the case of the hardest and most brittle calculi, be readily effected as follows. The calculus is to be sawn through with a fine sharp saw. The cut surface is next to be ground smooth, by being rubbed down upon a smooth flat hone with water. When it is perfectly even, it may be washed, and allowed to dry. Lastly, the cut surface is to be varnished; and now all the different layers will be seen most distinctly. If the calculus be very brittle and hard, unless it be sawn through with a diamond wheel, it is better to grind away one-half without attempting to saw through it. Small calculi are very easily ground and polished, and often furnish very instructive specimens.

The concentric layers are often of different colours, of

different degrees of hardness, contain various proportions of organic base, and are of different chemical composition. Each ring forms the section of a layer, and a portion of each may be detached and chemically examined separately. Some of these layers are deposited quickly, others more slowly; and they therefore vary considerably in hardness. In examining a calculus, it will therefore be necessary to subject a small portion of several layers separately to examination.

Seldom can any definite crystalline form be made out, except upon the surface of the concretion; and, upon examining small portions of a calculus in the microscope, nothing but a great number of crystalline fragments, exhibiting concentric layers, can usually be distinguished. Sometimes the material is deposited in little spherical masses, which become incorporated. Although distinct names are assigned to different forms of calculi, a concretion entirely composed of only one substance is seldom met with.

Of the Classes of Urinary Calculi, and of the Chemical Examination of Calculi. For convenience of description, calculi may be arranged in two classes, according to the relative proportion of the organic matter and inorganic salts present. The *combustible*, or *almost entirely combustible* calculi, are those which leave very little residue after exposure to the action of a red heat on platinum foil; while the *partially combustible* or *incombustible* calculi leave a considerable proportion of fixed residue.

I. *The first class* will include calculi composed of uric acid, urates of ammonia, soda, lime, and magnesia, and the rare forms of uric or xanthic oxide calculi, fibrinous and blood calculi, and those consisting of cystine.

II. *The second class* will contain the oxalate of lime or mulberry calculus; the calculi composed of various phosphatic deposits; that consisting of carbonate of lime, very rare in the human subject, but not uncommon among the lower animals; and the silicic acid calculus.

The first preliminary test to which a portion of calculeous matter of unknown composition is subjected, consists in exposing it to the action of a red heat. When reduced to a fine powder, a little is placed upon a piece of platinum foil, and heated in the flame of a spirit-lamp. If a carbonaceous mass remain, it is to be exposed for some time to a red heat, until it is entirely dissipated, or until nothing but a white ash remains.

If it be almost entirely dissipated, the original powder is to be tested for uric acid, urates of soda, lime, ammonia, or cystine, according to the method described for testing for these substances occurring in the form of urinary deposits.

If the powder be incombustible, or only partially combustible, it is to be tested for phosphate of lime, triple phosphate, and oxalate of lime, by the methods indicated. (See Tables.)

Tests kept in Small Bottles with Capillary Orifices. Let me direct your attention to a very convenient plan of keeping reagents, which is not only applicable to the subject now under consideration, but will be found of great advantage in all cases in which only a very small portion of matter is to be subjected to examination, particularly in ascertaining the chemical characters of substances which form the subject of microscopical inquiry—in fact, the plan of examining the chemical composition of a substance which I am about to describe may be termed not inaptly *microscopical testing*. A chemist may carry his laboratory in his pocket; and the physician may take all the apparatus necessary for the most complete qualitative examination he is ever called upon to make, in a space much less than that now usually occupied by the urinometer, spirit-lamp, and acid-bottles.

These little test-bottles which I now show you may be kept in a case. When we proceed to test a small

portion of calculeous matter, it is to be powdered, and placed on a glass slide. The cap is removed from the test-bottle containing the appropriate reagent, which is then inverted, and its capillary extremity placed near to the matter or drop of solution to be tested. The warmth of the hand expands the air contained in the bottle, and a drop of the liquid is expelled.* (*How to Work with the Microscope, The Microscope in Practical Medicine.*)

In this way, a drop of an unknown solution can be readily subjected to the action of several tests, and indications of the presence of certain substances may be obtained as clearly as if much larger quantities were operated on. In testing for carbonates, the powder or solution may be lightly covered with a piece of thin glass, and the acid subsequently added; the slightest effervescence becomes at once clearly perceptible; and, if necessary, the specimen may be subjected to microscopical examination, and thus the smallest disengagement of air-bubbles can be detected.

CLASS I. *Calculi which leave only a Trace of Fixed Residue after Exposure to a Red Heat.*

Uric Acid Calculi. Nearly two-thirds of the calculi in the museums of this country consist in great part of uric acid. They vary very much in size. Sometimes small calculi are found in great number in the kidney. For the most part, the uric acid is deposited in the first instance in the kidney itself; and not unfrequently the small concretion becomes impacted in the lower part of the uriniferous tubes or infundibula, and gives rise to great irritation, until it becomes released, and passes down the ureter into the bladder. It may now pass off by the urethra; or may remain in the bladder, when layer after layer is added, until it attains a considerable size.

Fig. 53.—Uric acid deposited upon a smaller calculus composed of oxalate of lime.

The uric acid calculus is usually of an oval form, but somewhat flattened on two of its surfaces. It is sometimes quite smooth externally, sometimes rough, or covered with a number of rounded projections. It is generally of a brownish hue, varying from a pale fawn colour to a dark brownish red. Dr. Rees met with one specimen in which the nucleus was quite white, and was composed of pure uric acid destitute of colouring matter. Its consistence is usually hard, and its texture compact. It breaks up into small angular pieces. I have examined many small uric acid calculi, and in several instances have found that the nucleus consisted of matter insoluble in potash, which polarised readily; and, in some specimens, well defined dumb-bell crystals of oxalate of lime were discovered. In some few cases, the nucleus probably consisted originally of mucus or some soft matter, which after a time had shrunk and nearly dried up, leaving a space or cavity in the centre of the calculus; but, even in these, matter insoluble in potash and acetic acid exists. Very generally, dumb-bells of oxalate of lime form the nucleus of uric acid calculi. The uric acid calculus is often coated with phosphates. The irritation of the calculus, according to Dr. G. O. Rees, excites the secretion of an abnormal quantity of alkaline fluid from the mucous membrane of the bladder, which causes the earthy

* These test-bottles are to be obtained of Mr. Matthews, Portugal Street, Lincoln's Inn. Some are fitted up in a box, with appropriate apparatus for examining urine.

phosphates to be precipitated from their solution in the urine. If ammonia were set free by the decomposition of the urine, it is possible that a little of the uric acid calculus might even be dissolved; but this would soon be prevented by the deposition of earthy phosphate upon the surface. The phosphates are not secreted in increased quantity by the mucous membrane of the bladder, as was formerly believed, but are precipitated from their solution in the urine.

Chemical Characters. Insoluble in boiling water; soluble in potash. From the alkaline solution, crystals of uric acid may be obtained by adding excess of acid. The murexide test may be applied. (See Uric Acid.) When heated on platinum foil, it evolves an odour of burnt horn. Carbonate of ammonia and hydrocyanic acid are among the products of decomposition. The small amount of residue which remains after the ash has been exposed to a red heat for some time, consists principally of phosphates and carbonates of soda and lime.

Calculi composed of Urates. These calculi usually contain urates of soda, ammonia, and lime; and not unfrequently small quantities of oxalate of lime are deposited with the urates. This calculus is in great part soluble in boiling water, and gives off ammonia when heated with a strong solution of bicarbonate of potash. Dr. Prout states that it is principally met with in children, and is usually small in size, of a pale brown colour. Layers of urate are often found in uric acid calculi.

Chemical Examination. After treating the calculus with boiling water, the insoluble matter is to be separated by filtration. This may consist of oxalate of lime and phosphates. If only a little boiling water has been added, the urate will be deposited as the solution cools. The solution is to be tested as follows. Acetic acid precipitates the uric acid. Filter, evaporate the solution to dryness, and expose the residue to a red heat. Carbonate of soda and carbonate of lime remain. The last may be obtained by solution in acetic acid and precipitation as oxalate.

Uric Acid, Xanthic Oxide, Xanthine. These names have been given to a rare form of calculus, which has only been found in man on three occasions. It is not soluble in water; it is hard, of a yellowish brown colour, and the surface can be polished by friction. Scherer has found xanthine in the liver and spleen, in muscle, and in blood. It is closely allied to uric acid, and also to hypoxanthine, which only differs from it in containing two atoms more of oxygen.

Cystic Oxide, Cystine. This form of calculus is of a pale greenish colour; its surface is smooth, and there are no indications of concentric layers. The fracture is glistening, and the structure is semitransparent.

The chemical characters of this calculus are the same as those of cystine.

Fibrinous Calculus. This form was first noticed by Dr. Marcet, and it appears to consist entirely of an elastic organic substance closely allied to fibrine. It is said to resemble yellow wax in its appearance. It dissolved in potash, but was precipitated by excess of acid. It was insoluble in water, alcohol, and ether; but was dissolved by acetic acid, with the aid of heat. In this solution, ferrocyanide of potassium produced a precipitate. It left very little fixed residue after exposure to a red heat.

Blood-Calculi. Dr. Scott Alison furnishes the following interesting remarks with reference to a case in which he discovered some blood-calculi in the kidney. (*Archives of Medicine*, vol. i, p. 245.) In examining the body of a man named William Solly, who was admitted into the Consumption Hospital, Brompton, under the care of Dr. Cursham, on August 23rd, and who died on the 30th of the same month, the left kidney was found by Dr. Alison to be greatly atrophied and changed in structure, while the infundibula and pelvis

were stuffed with hard bodies, most of which were of a coal-black colour. "The black calculi occupied the pelvis, while the infundibula were tenanted with a few calculi of a whitish grey colour, with one exception small in size, about the magnitude of pear-seeds, and wanting the ordinary physical characters of phosphate of lime. One calculus, which occupied an infundibulum, is the size of a horse-bean, looks somewhat worn and disintegrated, and at one point resembles a piece of decayed wood. At one side it is black, from the presence of altered blood. It is very light in weight, and is composed of blood and phosphate of lime. The black calculi, which form the chief point of interest in the case, were about six in number, and ranged from the size of a coriander-seed to that of a small horse-bean. When found, these black calculi were tolerably hard; but, being friable, they partly broke asunder in handling. The fractured surface varied a little in colour, in some parts presenting a dark rusty tint." Liquor ammoniac dissolved them; they were capable of partial combustion. The microscope revealed only amorphous particles; but Dr. Owen Rees, with the assistance of a neutral saline solution, discovered forms which he considered to be the remains of blood-corpuscles.

The kidney was remarkably altered. It was very small, but retained somewhat of the normal shape. It weighed only an ounce and a half, and was only two inches in length. Its colour was drab; its consistence was firm and fibrous. At one extremity only could any natural cortical or tubular structure be found. The organ resembled a sac with thin irregular walls. The lining membrane appeared healthy. The renal artery was small, thickened, and scarcely admitted a common probe. The ureter was small, but less out of proportion than the artery. The investing membrane could not be separated from the other parts with which it was connected.

"The atrophy of the kidney in this case was probably brought about by the production of inflammatory action, set up perhaps by the presence of small calculi of phosphate of lime. Blood was probably effused in consequence, and, from suppression of urine, remained in the infundibula and pelvis, and failed to be washed down the ureter. This blood hardening would form the calculi which were discovered. After the abatement of the supposed inflammatory action, degenerative processes would supervene, and lead to the remarkable atrophy and change which the kidney presented. The duties of this altered kidney would be thrown upon the other; but, as the system was much wasted by disease, no increase of size would result.

"Only a very imperfect history of the patient could be obtained, he being very exhausted when he came into hospital. Since his death, inquiries have been made for information, but with little success. He was fifty-two years old, and by trade a painter. He had been ill with cough two years, and his feet and legs became oedematous only two weeks previous to his decease. No information could be obtained respecting his having suffered from calculi in the bladder, or from hæmaturia; but it is right to mention that no member of the family of the deceased could be found."

Fatty Concretions. These have been already alluded to under *Urostealith* (Lecture VIII.) Specimens of urine which contain large lumps of hard fatty matter will sometimes be brought to you for examination, and you should be aware of the fact that these are almost invariably cases in which the fat has fallen into the urine accidentally, or has been placed in it for the express purpose of imposing upon us. Quite lately I have seen two such specimens, which were said to be cases in which concrete fatty matter had been passed in the urine. In these, however, the fat was ordinary suet, as was proved by the presence of the fat-vesicle, white and yellow fibrous tissue, and fragments of vessels.

[To be continued.]