ON
URINARY
AND OTHER
MORBID CONCRETIONS.

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THE analysis of urinary concretions is a subject of chemical research, which has already been investigated with so much ability and success, that it can never be expected to supply little more than a few scattered facts, that may have escaped the industry of former inquirers. My experiments, indeed, were for the most part made more than twelve years ago ; and such of the results, as have not already appeared in an Inaugural Dissertation on the Uric Acid, printed in 1807, were reserved, as I there intimated, for a larger work on Stone and Gravel, which, at that time, I had it in view to undertake. This, if other impediments had not occurred to its execution, is now completely superseded by an excellent “ Essay on the Chemical History and Medical Treatment of Uri-

nary Calculi," lately published by Dr. Marcet. One effect of the delayed fulfilment of my purpose has been, that I have been anticipated by other writers, as to several of the facts that had occurred to me. Some of these, however, it may still be proper to state in general terms, as they furnish additional evidence on points that have been the subjects of differences of opinion.

The urinary concretions from the bladder, which I have examined experimentally, amount in all to 187. Of these, 34 were extracted by the late Mr. Ingham, of Newcastle upon Tyne; 35 by the late Mr. White, of Manchester; 25 by Mr. Hey, of Leeds; 23, partly by the late Mr. Gibson, and partly by Mr. Ainsworth, both of this town; and the remaining 70 have been given to me by surgical practitioners in this place*, and in various parts of the kingdom, with the obliging view of facilitating my inquiries. The number of the different varieties of calculi in these several collections is stated in the following Table, which exhibits them in a sort of natural order, differing from the chemical arrangement, which I have proposed in another place, and which I still prefer for most of the purposes of classification.

* Especially by most of the late and present surgeons of the Manchester Infirmary: and to Mr. Ransome, one of the surgeons of that charity, I am indebted for dividing the calculi by a saw, without which division, collections of urinary concretions can afford no useful information.

TABLE I.
Shewing the Number of each Variety of Calculus in several different Collections.

	Chiefly Uric Acid.	Earthy Phosphates.	Oxalate of Lime.	Compound.	Cystic Oxide.	ALTERNATING CALCULI.				Total.
						UricAc. and Phosph.	Oxal. and Phosph.	Oxal. and Uric Ac.	Oxal. UricAc. & Phos.	
Mr. Ingham's	15	1	0	1	0	7	3	3	4	34
Mr. White's.....	19	7	3	0	0	3	2	1	0	35
Mr. Hey's.....	9	4	2	0	0	7	2	0	1	25
Mr. Ainsworth's	7	2	2	1	0	6	2	1	2	23
Own Collection	21	8	4	6	2	16	7	6	0	70
	71	23	11	8	2	39	16	11	7	187

From the preceding Table, I have calculated the following, exhibiting the proportion which each kind of concretion bears to the whole number in the different collections. For example, in Mr. Ingham's collection, the calculi consisting chiefly of uric acid are to the whole number as one to one and two tenths; in Mr. White's, as one to one and eight tenths, the second decimal figure being omitted throughout as unnecessarily minute.

TABLE II.

Shewing the Proportion of each Variety of Calculus to the whole Number in the different Collections.

Kind of Calculus.	INGHAM. Newcastle.	WHITE. Manchester.	HEY. Leeds.	AINSWORTH. Manchester.	OWN.	Whole Number.
Chiefly Uric Acid.....	1 to 2.2	1 to 1.8	1 to 2.7	1 to 3.3	1 to 3.2	1 to 2.6
Earthy Phosphates.....	1 to 34.	1 to 5.	1 to 6.	1 to 11.5	1 to 8.8	1 to 8.5
Oxalate of Lime.....	.....	1 to 11.6	1 to 12	1 to 11.5	1 to 17.7	1 to 17.
Compound.....	1 to 34.	.....	.....	1 to 23.	1 to 11.8	1 to 23.5
Alternating.....	1 to 2.	1 to 3.2	1 to 2.4	1 to 2.2	1 to 2.4	1 to 2.5
to { Uric Acid and Phosphates	1 to 4.8	1 to 11.6	1 to 3.4	1 to 3.8	1 to 4.4	1 to 4.8
to { Oxalate and Phosphates ...	1 to 11.2	1 to 17.5	1 to 12	1 to 11.5	1 to 10.1	1 to 11.6
to { Oxalate and Uric Acid.....	1 to 11.2	1 to 35.	.....	1 to 23.	1 to 11.8	1 to 17.
to { Uric Acid Oxalate and	1 to 8.5	.....	1 to 24	1 to 11.5	.....	1 to 26.5
to { Phosphates .....	.....	.....	.....	.....	.....	1 to 98.5
Cystic Oxide.....	.....	.....	.....	.....	.....	.....

The greater proportion of uric acid calculi in Mr. White's collection, than in that of Mr. Gibson and Mr. Ainsworth, may, on first view, appear extraordinary, as those three gentlemen all practised surgery in the same town. It will be found, however, in the joint collection of the two latter, to be compensated by a much greater number of that variety of alternating calculus, which is composed of uric acid and the phosphates in distinct layers. It may be remarked, also, that the greater number of Mr. White's operations were performed at a very remote period of time, when little interruption was given to the natural progress of the disease by the use of alkaline medicines, and that his patients were chiefly from a distance. Of late years, in consequence of the increase of public hospitals in the adjoining counties, cases requiring lithotomy occur comparatively very seldom at the Manchester Infirmary; and the town, and district immediately surrounding it, may be considered as remarkably unproductive of stone patients, though cases of gravel occur, so far as I have the means of judging, as frequently as in other remote districts*.

* It is a well ascertained fact, and one which should give encouragement to persons labouring under gravel, that this disease occurs very frequently without degenerating into stone; and that it is even endemic in districts where the stone is a very rare disease. See Beverwyk de Calculo, p. 78. Carleton de Lithiasi, p. 118. and Heberden Comment. p. 78.

In the collection of Mr. Ingham, of Newcastle, the proportion of calculi composed entirely of the earthy phosphates is unusually small, but is compensated by the number of concretions in which the phosphates alternate with uric acid. On the whole, indeed, there is a remarkable uniformity in the composition of calculi generated in districts very remote from each other, a fact which proves that the causes rendering the stone endemic in certain countries act, not as was once imagined in supplying directly the material of which the concretions are composed, but in inducing a constitutional tendency to the disease.

It was the opinion of some of the older writers, that all calculous concretions (with the exception of such as are formed on extraneous substances accidentally introduced into the bladder) do in fact originate in the kidneys, and descending through the ureters, merely acquire an increase in the bladder by attracting solid matter from the urine. To this opinion, which Fernelius especially has ably supported*, it has been objected that stone in the bladder is in many instances not preceded by any pain in the region of the kidneys, or by the symptoms that denote the descent of a stone through the ureter†. It is perfectly conceivable, however, that a small calculus may find its way

* Fernelii Opera, p. 317, folio.

† Beverwyk de Calculo, p. 69.

from the kidneys to the bladder, without exciting pain in its passage. The opinion of Fernelius and of others who agree with him, I find also to be confirmed by the appearance of almost all the calculi which I have ever examined, after having been divided by the saw ; for, except in very few instances, a central nucleus may be distinctly seen, sufficiently small to have descended to the bladder through one of the ureters, even when that passage has not been dilated beyond its natural diameter. The stone therefore is to be considered, essentially and in its origin, as a disease of the kidneys. Its increase in the bladder may be occasioned either by exposure to urine containing an excess of the same ingredient as that composing the nucleus, in which case it will be of uniform composition throughout ; or if the substance composing the nucleus should, either by a spontaneous change in the action of the kidneys, or by the effect of medicines, be secreted in less than natural proportion, the concretion will then, like any other extraneous body lodged in the bladder, acquire a covering of the earthy phosphates.

Under this view of the subject, it becomes highly important to ascertain of what ingredient the nuclei of urinary calculi are, for the most part, constituted, since it is in the tendency of the kidney to generate this ingredient, that the primary cause of the disease must consist. Of the 187 calculi which I have examined, 17 have been formed

round nuclei composed chiefly of oxalate of lime ; 3 round nuclei of cystic oxide ; 4 round nuclei of the earthy phosphates ; 2 round extraneous substances ; and in three, the place of the nucleus is supplied by a small cavity, occasioned probably by the shrinking of some animal matter, round which the ingredients of the fusible calculus had been deposited*. The remainder, amounting to 158, have a central nucleus composed chiefly of uric acid. It appears then that in a very great majority of cases, the disposition to secrete an excess of uric acid has been the essential cause of the formation of stone ; and it becomes important to inquire what are the circumstances that contribute to its excessive production, and by what plan of diet and medicine the tendency to its too great secretion by the kidneys may best be counteracted or removed. This inquiry, however, is not within the scope of the present essay, which is limited to the chemical composition of the concretions when actually formed.

Of Uric Acid Concretions.

It has never yet occurred to me to examine a calculus composed of this acid in a state of absolute purity. Of the concretions which I have classed under this head, a considerable number,

* Rau has shewn, by a direct experiment, that pus may form the nucleus of an urinary concretion. See Denys de Calculo Renum, &c. p. 14.

after the action of pure potash, have left an insoluble residue of the earthy phosphates; and from the solution of these even, which have entirely dissolved in that menstruum, I have in no case been able to recover by the addition of acids, a quantity of uric acid equivalent to the weight of the calculus dissolved. The utmost that I have ever obtained has been 92 parts from 100 of an uric concretion. On this subject, therefore, my experience entirely agrees with that of Mr. Brande*. The loss doubtless arises from the decomposition of animal matter by the alkali. This, as I have stated in my Thesis, is partly urea, which, I found, may be separated by digesting the powdered calculus in alcohol, and evaporating the solution†. It is not, however, to urea that the colour of uric acid calculi is to be ascribed, but rather to the other substances which in urine generally accompany it; for it has been shewn, by Professor Berzelius and by Dr. Prout, that pure urea is destitute of colour. In one instance only I have observed a vesical calculus composed chiefly of uric acid, to be of the whiteness of chalk; and from this the action of alcohol did not extract any portion of urea. Gelatine I have never been able to discover, by applying its appropriate test to water which had been digested in the powdered calculus; but the presence of albuminous matter appears to me to be indicated by light flocculi, which sometimes float

* Phil. Trans. 1808.

† Dissert. Inaug. 1837, p. 39.

over the uric acid, when precipitated by acids from its solution in alkali. It is probable, however, that the characteristic ingredient of urinary calculi does not necessarily require a cement to bind it together, but that the aggregative attraction of its particles is sufficient to unite them into a compact mass. All curative plans, therefore, which have in view the removal of a cementing ingredient (the mode in which Haller and Hartley explained the action of alkaline solvents) appear to me to be without probable grounds of success.

Urate of ammonia, I believe with Mr. Brande, has been erroneously set down by Fourcroy and Vauquelin as an ingredient of urinary calculi. At least, I have never found any indications of its presence in calculi which had been previously subjected to the successive action of alcohol and of acetic acid; menstrua, which would remove urea and the ammoniaco-magnesian phosphate, but would not, in the quantities employed, have separated urate of ammonia.

Several opportunities have been thrown in my way of examining urinary calculi, extracted from persons who had been long under a course of caustic alkaline lixivia. In one of these (No. 13. of Mr. Ingham's collection) the outer surface of the calculus might, on first view, have been supposed to have been eroded: but a closer examination satisfied me that the appearance was owing,

not to the solution of the uric acid, of which the concretion chiefly consists, but to an irregular deposit of the earthy phosphates, occasioned probably by the medicine. Another calculus in the same collection (No. 15.) taken from a person who had long been using Perry's solvent, was so brittle, that on attempting to divide it by the saw, it separated into concentric coats, composed of uric acid with a large proportion of the earthy phosphates. The third is a fusible calculus, now in my possession, of remarkable whiteness and compactness, and containing no appreciable portion of uric acid. In a fourth instance, a calculus, put into my hands by Dr. Brown, of Glasgow, which had been taken from a person after so free an use of alkaline medicines as to have injured his general health, consisted chiefly of the triple phosphate of ammonia and magnesia. It was so brittle that it broke almost into powder under the forceps, and was therefore extracted by the scoop. These cases, and others of the same kind, which I think it unnecessary to mention, tend to discourage all attempts to dissolve a stone supposed to consist of uric acid, after it has attained considerable size in the bladder; all that can be effected under such circumstances, by alkaline medicines, appears, as Mr. Brande has remarked*, to be the precipitating upon it a coating of the earthy phosphates from the urine, a sort of concretion which, as has been

* Philosophical Transactions, 1808.

observed by various practical writers, increases much more rapidly than that consisting of uric acid only. The same unfavourable inference may be drawn also from the dissections of those persons, in whom a stone has been supposed to be dissolved by alkaline medicines; for in these instances it has been found either encysted or placed out of the reach of the sound by an enlargement of the prostate gland. The former source of fallacy was shewn to have existed even in one of the cases which procured to Mrs. Stevens the parliamentary reward of £5000*; and examples of the latter kind have been related by Dr. Heberden and Sir Everard Home.

Two instances have fallen within my knowledge, in which persons have voided quantities of uric acid with the urine, far exceeding any thing that I can find upon record. In the first, which was mentioned to me by Professor Memo, of Edinburgh, every pint of the urine voided by a man about forty years of age, who laboured under symptoms of gravel, deposited about two ounces of a brick-coloured sediment, which I found on examination to be chiefly uric acid with a very small relative proportion of the earthy phosphates. In another instance, a lady of middle age, who was subject to gravel, was in the habit, when warned of its approach by the usual symptoms, of having recourse

* Newman's Inquiry into the Merits of Solvents, London, 1781.

to a medicine, the composition of which is kept secret, but which appears to me to be nothing more than spirit of turpentine coloured by a little petroleum, with the addition of a portion of tincture of opium. The uniform effect of this medicine was the discharge of a sandy substance in such quantity, that more than four ounces were sometimes voided within the space of two or three days. It was composed chiefly of uric acid, with a small proportion of urea and of the earthy phosphates. I have since known another instance in which the same medicine has produced a similar effect, though not to an equal extent, probably by acting as a stimulant to the kidneys; and clearing them, by the increased flow of urine which it excites, of the sand that had been deposited in the tubuli uriniferi and pelves of those organs.

Calculi composed chiefly of the Earthy Phosphates.

The pure phosphate of lime, or bone earth calculus, I have not been able to recognize in any of the collections of calculi which I have examined, though assisted by a recollection sufficiently distinct of one which was shewn to me some years ago by Dr. Wollaston; nor have I ever found the triple phosphate of ammonia and magnesia composing, in a pure state, an entire calculus, though in Mr. White's collection there is one containing more than 90 per cent. of that salt. From this proportion I have found it in a variety of others,

down to 20 and even 10 per cent. With phosphate of lime, in proportions which seem to have a considerable range, it constitutes the fusible calculus, and this mixture forms the principal ingredient of calculi that have concreted round foreign substances. A calculus in Mr. White's collection, the nucleus of which is a bougie that had slipped into the bladder, is composed of

Phosphate of lime . . .	20
Ammoniac-magn. phosph. . .	60
Uric acid	10
Animal matter	10
	<hr/>
	100
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In four instances only out of 187, the calculus has been composed throughout of the earthy phosphates; and in these I have not been able to discover a nucleus of any other substance. I consider the fact therefore as sufficiently established, that in some instances, though comparatively very few, a tendency to secrete the earthy phosphates in excess is a cause of the formation of stone, first probably in the kidneys, and subsequently in the bladder. This tendency, indeed, as is well known, sometimes manifests itself by the discharge of urinary gravel, consisting of the triple phosphate either alone or in conjunction with phosphate of lime.

Several years ago, the Rev. Mr. R. of Cheadle, in Staffordshire, consulted me respecting a train of very distressing symptoms, some of which evidently denoted considerable disease in the kidneys. His urine, which at some times was perfectly limpid, was at others loaded with a white substance, which gave it when first voided the opacity of milk. On standing, a copious deposit took place, a portion of which was sent to me for examination. It was perfectly white, and so impalpable as to resemble a chemical precipitate. On analysis, it proved to consist of nearly equal parts of the triple phosphate and phosphate of lime. The discharge of this powder was always preceded by violent attacks of sickness and vomiting, and its quantity was invariably increased whenever he took soda water or any other alkaline medicine. Beside the affection of the kidneys, there appeared to me to exist important disease of the chylopoietic viscera, and to this I ascribe his death, which took place a few months afterwards. In this case, it was remarkable that the weight of the body was reduced from 183 to 100 pounds at rather an early stage of the disease, without a corresponding degree of muscular emaciation, owing, obviously, to the imperfect nutrition of the bones, in consequence of the waste of the phosphate of lime through the urinary passages.

Mulberry Calculus.

In calculi of this description I have always

found, with Dr. Wollaston and Mr. Brande, an admixture of other substances with the oxalate of lime, which is to be considered as their characteristic ingredient. One of the best marked specimens I have ever seen of the rough kind afforded, from 10 grains, 5.3 grains of carbonate of lime, equivalent to nearly 6.6 of oxalate, 1 gr. of uric acid, 0.3 gr. of phosphate of lime, and a quantity of dark-coloured flocculi of animal matter, which did not descend along with the uric acid, when the latter was precipitated from its alkaline solution. These flocculi were soluble again in pure potash, but not in alcohol or in dilute acids. The colouring ingredient of this variety of calculus is communicated both to caustic alkalis and to concentrated muriatic acid, the latter of which becomes tinged like a strong infusion of roasted coffee. On diluting the solution, part of the oxalate of lime is deposited, but the colouring matter remains dissolved. It is probably derived originally from effused blood, for the smooth variety of calculus which consists chiefly of oxalate of lime, is not distinguished by this dark shade of colour,

Cystic Oxide Calculi.

By means of Dr. Wollaston's clear description of this rare variety of calculus, I have recognised two specimens of it in my own collection, but with the histories of both I am wholly unacquainted. They have obviously been extracted from the bladder; the one when entire weighing 660 grains,

and the other 334. In each, the nucleus is the same substance as the rest of the concretion ; and in a third specimen, also in my possession, a very small spherule of cystic oxide forms the nucleus of a moderately sized calculus, the rest of which consists of uric acid. This oxide appears, therefore, as Dr. Marcet has properly remarked, to be in reality the production of the kidneys, and not, as its name would import, to originate in the bladder.

Calculi, the Ingredients of which are disposed in alternate Layers.

Of these I have little more to observe than will be suggested by inspecting the first Table ; viz. that calculi composed of layers of uric acid and the earthy phosphates are, in the collections which I have examined, the most frequent variety of the alternating kind ; next follow those of oxalate of lime and the phosphates ; then concretions of oxalate of lime alternating with uric acid ; and lastly, those occur most seldom in which the three substances just mentioned alternate together. I have not met with an instance of a calculus containing four ingredients in distinct layers ; and it appears, from the testimony of others, that such examples are extremely uncommon.

Foreign Substances voided in the Urine.

I have related in a periodical medical journal*,

* Edin. Med. Journ. vii. 147.

the case of an elderly gentleman, who discharged in his urine the larvæ of an insect, which when first voided were alive and vivacious, and so far as could be made out by an eminent naturalist, belonged to some species of the coleopterous order. In this case, though the patient would not consent to be sounded, there was doubtless a stone in the bladder, and, as appeared to me, extensive disease of the bladder itself and of the prostate gland; but no examination I believe was made after his death, which was occasioned suddenly by a fit of apoplexy.

I have lately been made acquainted, by a gentleman of middle age, with a singular discharge which he frequently observes in his urine, of a considerable number of short hairs. Besides that he is above all suspicion of being deceived himself, or deceiving others, I have satisfied myself, by the most careful investigation, that they have their origin from the inner surface of the bladder, or from some of the urinary passages. They are of various lengths, from $\frac{1}{10}$ of an inch to an inch, and now come away without giving him any uneasiness, though he has at times suffered pain from the discharge of gravel of the uric acid kind. On one occasion the hairs which were voided had acquired, before their discharge, a distinct coating of uric acid. The symptoms having at one time excited suspicion of a stricture of the urethra, a bougie was twice introduced without giving him pain; nor was its use

followed by any increase of the number of hairs that were voided, which might perhaps have been expected, if they had grown from the membrane of the urethra*.

Of Morbid Concretions from other Parts of the Body.

PULMONARY CONCRETIONS. A pulmonary calculus, expectorated several years ago by a patient of the late Dr. Ferriar, was found to be chiefly composed of phosphate of lime, with a very minute proportion of carbonate. Such also has been the composition of other specimens, given to me by Dr. Baron, of Gloucester; but a remarkably large one in the possession of Mr. Ainsworth, which weighed when entire 51 grains, and exhibited a

* When examined chemically these fibres do not appear to differ from common hair; but it has been observed by Dr. Wollaston, that they differ in some respects in their mechanical texture, since they have not that slight roughness in one direction of the surface on which the *felting* property of common hair of every kind depends. This property of hair is most distinctly shewn by pressing it between the fingers, and at the same time sliding the fingers upon each other in the direction of the hair, which will by this motion be seen to travel forward with its root foremost. The finger which moves *from* the root slides freely along the hair, while the other finger is prevented from sliding in the opposite direction by a degree of roughness (which is thus sensible though not in any way visible) but in its turn this finger also will move from the root while the hair now rests against the opposite finger. It has also been remarked by Dr. Wollaston, that common hairs are not really tubular, as has often been asserted, but that these fibres really are so.

complete cast of one of the bronchial cells, is principally composed of the triple phosphate, with a very small relative proportion of phosphate of lime, and a mere trace of carbonate. Some concretions taken from the lungs by the late Mr. Allan Burns, of Glasgow, have their earthy part composed of about one fifth of the triple phosphate, and four fifths of phosphate of lime, with a minute proportion of the carbonate of that earth. The subject, from whom these concretions were taken after death, I was informed by Mr. Burns, was a female about fifteen years old, who, though affected with violent cough, had never expectorated any calculous matter. The spine in this case was so much incurvated that, towards the close of life, the face approached nearer to a horizontal than to a perpendicular line. The substance of the lungs when grasped was felt to be full of hard knots, from the size of a pea to that of a hazel nut; and a concretion, about the size of a large musket-ball, was found firmly impacted in the left branch of the trachea, near to its origin. By a careful examination of the concretions in the substance of the lungs, Mr. Burns ascertained that each was lodged in a bronchial cell, and was enveloped in a distinct capsule, which admitted of being readily separated from the membrane of the air cell. Indeed in all concretions discovered in the soft parts of the body, Mr. Burns informed me that he has uniformly found a peculiar substance containing the solid substance, and over this another sheath of

dense membrane. The inner covering he supposed to belong essentially to the concretion, and the outer one to be formed in consequence of the irritation caused by the presence of an extraneous body.

CALCULI FROM THE SPLEEN. For the opportunity of examining these, I was indebted to the same zealous and able anatomist. They were of small size, shaped like a pear, of a yellowish white colour, and were composed of bone earth, without any portion of the triple phosphate.

SMALL CRYSTALS FORMED ON THE SURFACE OF A CANCEROUS PREPARATION, KEPT IN SPIRIT OF TURPENTINE. These also, I received from Mr. Burns; and though not strictly belonging to the class of morbid concretions, I mention them here, on account of their singular composition. They are in very minute parallelopipedons, are fusible when placed on a piece of iron heated below redness, and evaporate in an aromatic smoke. They are very sparingly soluble in water, but more so in alcohol; and the latter solution, when concentrated, reddens litmus paper. They agree therefore in their properties with the camphoric acid, and furnish an instance of the production of that acid under circumstances not before observed. Whether they had passed through the intermediate state of camphor, which, by well known treatment, may be obtained from spirit of turpentine, it is now im-

possible to ascertain. Mr. Burns, however, assured me that they may not unfrequently be seen on preparations kept in that fluid ; but never, except when the parts have been imperfectly dried before being immersed in it. It is probable, therefore, that they may be found under similar circumstances in other anatomical collections.

Manchester, Dec. 16, 1818.