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IV. *Experiments and Observations tending to show the Composition and Properties of Urinary Concretions.* By GEORGE PEARSON, M. D. F. R. S. Read before the Royal Society, December 14, 1797. From the Philosophical Transactions.

[Concluded from the last Number, page 54.]

I SHALL next relate some experiments, made in order to obtain the acid sublimite of Scheele, or lithic acid of the new system of chemistry.

100 grains of an urinary concretion, which had been previously found to contain principally the above animal oxide, were introduced into a tube $\frac{1}{4}$ of an inch wide ; which was sealed at one end by fusion, and which also was fitly bent for collecting sublimite, and obtaining gaz. The sealed end was coated and exposed to fire, first to a low temperature, and gradually to a very elevated one.

1. Gaz was discharged, which had the smell of burning bone.

2. Water appeared boiling immediately over the charge, which seemed to be burning, and was turned black.

3. Gaz was discharged, of the smell of empyreumatic *liquor cornu cervi*, and about half a drachm of this liquor was in the upper part of the tube.

4. A brown sublimite of carbonate of ammoniac appeared in the cold part of the tube ; but in the hotter part near the charge, was tar-like matter, and the gaz discharged had a very offensive smell of empyreumatic animal oil, with which was mixed that of prussic acid.

The coated part of the tube was kept red hot, for some time after gaz ceased to come over.

The quantity of gaz amounted to 24 ounces, by measure : it consisted of nearly 16 ounces of carbonic acid gaz, and the rest was air, with a larger proportion of nitrogen gaz than is contained in atmospheric air.

5. There

5. There was a residue of 30 grains, almost pure carbon; and 10 grains of heavy black and brown matter, a little above the coated part of the tube. In this last-mentioned matter were many small white *spicula*. At about half an inch above the carbonaceous residue, dark gray matter had been raised, which weighed 15 grains.

This sublimed gray matter did not contain any ammoniac, nor throw down any prussiate of iron, with sulphate of iron. It reddened turnsole paper and tincture. It dissolved in caustic soda; from which solution muriatic acid precipitated nothing, for, although on dropping it into the solution milkiness appeared, the liquid soon grew clear again.

Ten grains of this sublimate dissolved in four ounces of boiling water; which being evaporated to half an ounce, there was, on cooling, a copious deposit of white *spicula**. The sublimate had a sharp, but not sour taste. Being boiled in muriatic acid, and also in nitric, it did not dissolve at all; but remained, on evaporation to dryness, in the same state as before: and it must be particularly observed, that it left no red or pink matter, on evaporating the nitric acid from it. Sulphuric acid did not act upon it in the cold; but, when heated, it dissolved it, without effervescence, from which solution nothing was precipitated by caustic soda: on evaporating it to dryness, black fumes arose, leaving behind only a black stain. This sublimed matter did not render lime water turbid. Boiled in muriatic acid, so as to carry off all but a very little free acid, on the addition of lime water there was no turbid appearance, but milkiness ensued on adding oxalic acid.

The *spicula*, in the 10 grains of sublimate above mentioned, seemed to be of the same nature as the matter just described.

The whole of this sublimate amounted, by estimation, to 18 grains; and I apprehend it is the acid sublimate of Scheele.

* From the deposition of these *spicula* by cooling, and from many of the following properties, they appear to be analogous to benzoic acid.

The sublimate of carbonate of ammoniac amounted to 20 grains; and it was black empyreumatic animal oil which stained the tube.

This experiment was repeated, on 120 grains of a nut-brown, very light, urinary concretion. The result was not very different from that of the former experiment, except that the gaz contained a portion of hydrogen gaz. There were 30 grains of the above described *spicula*, principally mixed with carbonaceous matter: they were light, and had only a very slight sharp and bitter taste.

The experiment repeated a third time, with 80 grains of urinary concretion, afforded 15 grains of the white *spicula* above described, mixed with carbonaceous matter. These I found did dissolve in a large proportion of muriatic acid; which solution yielded them, on evaporation, in the same state as before. Under the flame applied by the blowpipe, they first melted, and then evaporated, without any smell; leaving a slight black mark. Turnsole was reddened by these *spicula*.

In a fourth experiment, I found the white *spicula* contained in the carbonaceous matter united, on boiling, with carbonate of soda, as well as with caustic soda; but, as before, muriatic acid precipitated nothing from the solution. These *spicula* could not be dissolved in nitric acid; nor did the solution of them in water become turbid with oxalic acid. Their taste was, as before, rather bitter and sharp than sour. A very suffocating smell issued forth, on breaking the tube used in this experiment, but it was not from sulphur, nor from prussic acid.

These experiments afford evidence of the wide difference between the animal oxide above described and the acid sublimate of Scheele*.

* From these experiments, it now appears very doubtful whether the *lithic acid* of Scheele exists as a constituent of urinary concretions, or is compounded, in consequence of a new arrangement taking place, of the elementary matters of the concretion, by the agency of fire; but it is demonstrated, that the urinary animal oxide is really a constituent part, and even a principal one, of almost all human urinary calculi.

If

If this conclusion be allowed to be just, it will be necessary to give a name to this urinary animal oxide. Agreeably to the principles of the new chemical nomenclature, the name should be *lithic oxide*. But the term *lithic* is a gross solecism; and I trust that philological critics will find the name *ouric* or *uric oxide* perfectly appropriate; for, if it be thought objectionable, on account of the existence of the matter in arthritic as well as urinary concretions, still philology will allow its admission, as in other similar causes, $\kappa\alpha\tau'$ $\epsilon\acute{\epsilon}\chi\omicron\chi\eta\nu$; it being found in greater abundance, by far, in the urinary passages than in other situations, and therefore falling under common observation, as an ingredient of the urine. If, however, the term lithic oxide, or any other denomination, shall obtain acceptance, I shall very willingly adopt it.

It requires no sagacity, in a person acquainted with the facts of the preceding experiments, to perceive that they are applicable to a variety of uses in chemical investigation, and in the practice of physic. The latter I of course take no notice of in this place; but, relative to the former uses, I shall particularly point out, that we are now able not only to detect, in the easiest manner, the *presence* of the minutest proportion of the above animal oxide in urinary concretions, and also in other substances, but even to determine its *proportion* to the other constituent parts, in the space of a few minutes, in most cases, and in all in a very little time, without any other apparatus than nitric acid; a round-bottomed matras or glass dish, and a lamp. By this method, I have, in a general way, examined above 300 specimens of concretions, of the human subject and other animals, principally urinary ones; and also many from other parts, particularly those from the joints. For these opportunities, I am beholden to several professional gentlemen; whose willingness to furnish me with specimens, I shall have much satisfaction in acknowledging on a future occasion. At present, I must acknowledge my obligations to Mr. Heavyside, in whose museum I found between 700 and 800 specimens. The liberal possessor of this

treasure offered me, what I could not have taken the liberty of requesting, namely, permission to break off pieces from any of the articles, for experiment. Mr. Edward Howard did me the honour to take upon himself the task of writing down the reports, and otherwise assisted me.

At this time I shall only mention,

1. That out of 200 specimens of urinary calculi, not more than six did not contain the animal oxide above described, *i. e.* about 32 out of 33 contained it.

2. That the proportion of this oxide was very different; varying from $\frac{1}{200}$ (exclusive of water,) to $\frac{1}{200}$; but, for the most part, varying between $\frac{1}{200}$ and $\frac{1}{200}$ *.

3 That the common animal mucilage of urine is frequently found in concretions, in very different proportions; but is perhaps never a principal constituent part of them.

4. That the above animal oxide was not found in the urinary concretions, or any other concretions, of any animal but the human kind.

5. That this animal oxide was found also in human arthritic calculi, but not in those of the teeth, stomach, intestines, lungs, brain, &c.

P. S. I think proper to subjoin a few experiments, made after the preceding paper was written, which afford evidence of the truth of some of my conclusions, and enable us to explain several properties of animal concretions..

I. On an Urinary Concretion from a Dog.

This calculus may be said to be a great curiosity, for it is probably the only specimen in London. I owe the opportunity of examining it to Mr. H. Leigh Thomas, who met with it in the course of his dissections; and therefore we have unquestionable authority, that the concretion was

* In some urinary concretions, the interior part contained this oxide, and the exterior part had none of it. On the contrary, in other urinary concretions, the exterior part contained it, and the interior part did not.

really

really from the urinary bladder of a dog. It is worthy to be noticed, that the animal appeared to be in perfect health.

This concretion is of an oval figure; is three inches and three quarters in length, and three inches in breadth; is white as chalk; its surface is rough and uneven. Being sawed through longitudinally, no nucleus was found, nor was it laminated, but near the centre it was radiated, and contained shining *spicula*. In other parts it was, for the most part, compact and uniform in its texture. It weighed nearly ten ounces and a half. Its specific gravity was found to be greater than that of human urinary concretions, in general; which I have learned by experiments is also the case with urinary and intestinal concretions of other brute animals, especially with those of the horse.

The specific gravity of the present calculus was 1,7.

That of one from the urinary bladder of the human subject, of the sort called mulberry calculus, and which consisted almost entirely of uric oxide, was 1,609.

That of another human urinary concretion, of the same composition as the former, but quite smooth, extracted by Mr. Ford, was 1,571.

1. The present calculus of the dog had no taste, nor smell, till exposed to fire.

2. Under the blowpipe it first became black, and emitted the smell of common animal matter; it next smelt strongly of empyreumatic *liquor cornu cervi*; and, after burning some time, became inodorous, and white, and readily melted, like superphosphate of lime.

3. On trituration with lye of caustic soda, there was a copious discharge of ammoniac.

4. It dissolved, on boiling in nitric acid: the solution was clear and colourless; and, on evaporation to dryness, left a residue of *white bitter matter*, which, under the blowpipe, emitted, weakly, the smell of animal matter.

5. Upon distilling a mixture of 150 grains of this concretion pulverized and two pints and a half of pure water, to

three ounces, the distilled liquid was found to contain nothing but a little ammoniac. The three ounces of residuary liquid, being filtrated and evaporated, yielded 20 grains of phosphate of ammoniac, with a little animal matter; and the residuary undissolved matter amounted to 67 grains.

6. These 67 grains, being triturated with four ounces of caustic soda lye, discharged very little ammoniac. On distilling this mixture to one ounce, a very small proportion only of ammoniac was found in the distilled liquid. The residuary ounce of alkaline liquid was filtrated, and mixed with the water of elutriation of the undissolved matter. One half of those liquids, on evaporation to dryness, afforded a dark brown matter, amounting to 20 grains, which consisted of phosphate of lime and animal matter. To the other half of the alkaline liquids was gradually added muriatic acid, which occasioned a deposit, in small proportion, of matter that dissolved in nitric acid, but which, on evaporation to dryness, left behind only a brownish matter, consisting of phosphate of lime and animal matter.

7. The residuary insoluble substance in caustic lye, (6.) under the blowpipe, first turned black, and then grew white, but could not be melted.

By diluted fulphuric acid it was decomposed. On the addition of nitrate of mercury, to the filtrated liquid, it yielded phosphate of mercury; and, with oxalic acid, it afforded oxalate of lime; but no fulphate of magnesia was found remaining after these precipitations were produced.

These experiments fully demonstrate, that the above concretion of a dog contained none of the uric or lithic oxide above described, but that it consisted, principally at least, of phosphate of lime, phosphate of ammoniac, and animal matter.

The present instance leads me to explain the reason of the fusibility of calculi. This is demonstrated by the above experiments, to depend upon the discharge and decomposition of the ammoniac of the phosphate of ammoniac, during the burning

burning away of the animal matter: hence the residuary phosphoric acid readily fuses, and, uniting to the phosphate of lime, composes superphosphate of lime, a very fusible substance.

The phosphate of ammoniac being dissolved out by water, or caustic alkaline lye, the remaining matter is infusible, being phosphate of lime.

A very hard, brittle, and blackish intestinal calculus of a dog, from Mr. Wilson, was found to be of greater specific gravity than human urinary calculi, and to have the same composition as that of the dog above described.

This also was found to be the composition of a white, smooth, round, intestinal calculus of a horse, the specific gravity of which was 1,791.

The same composition was discovered, on examining a very hard, gray, brittle, laminated, quadrilateral concretion, said to be from the urinary bladder, but which, I think, was more probably from the intestines, of a horse.

II. On a Calculus from the Urinary Bladder of a Rabbit.

This is also a curiosity, being the only instance I have seen. I am likewise indebted to Mr. Thomas for this specimen, which he very kindly sent me, fitted up as a preparation, included in the bladder itself. Mr. Thomas found this concretion, on dissecting a perfectly healthy and very fat rabbit.

This specimen is spherical, and of the size of a small nutmeg. It is of a dark brown colour, has a smooth surface, is hard, brittle, and heavy. When broken, it appeared to consist of concentric laminæ. Its specific gravity was 2.

1. Under the blowpipe it grew black, and emitted the smell of animal matter while burning; at last it ceased to emit any smell; and, urged with the intensest fire, showed no signs of fusibility.

2. It readily dissolved, with effervescence, like marble, in both muriatic and nitric acids, giving clear solutions.

3. The

3. The nitric solution (2.) being evaporated partly to dryness, and partly to the consistence of extract, the dry residuary matter was white; and the extract-like matter, which was bitter, could not be fused under the blowpipe; but, when brought to the state of a powder, the particles of it were made to cohere loosely together into one mass.

4. On dropping sulphuric acid into the muriatic solution, (2.) turbidness, and a copious white precipitation, immediately ensued, from the composition of sulphate of lime.

From these experiments it is warrantable to conclude, that the above urinary calculus of a rabbit consisted principally of carbonate of lime and common animal matter, with, perhaps, a very small proportion of phosphoric acid: it certainly contained no uric oxide.

I examined, in the same manner, a concretion which was said to be from the stomach of a monkey; but I have not evidence of its origin equally satisfactory as that of the two last calculi. Its composition was found to be similar to that of the calculus of the rabbit, *viz.* carbonate of lime and animal matter. Its obvious properties were also the same; it was of the size of the largest nutmeg.

III. *On Urinary Concretions of the Horse.*

I examined several specimens in cabinets, said to be vesical calculi of the horse, and found none of them to contain the uric oxide above described; but that they consisted (as well as the calculi from the stomach and intestines of the same animal) of phosphate of lime, phosphate of ammoniac, and common animal matter, which melted like superphosphate of lime, after burning away the animal matter and ammoniac. As these, and some other experiments, seemed to concur in establishing an important truth, I thought it necessary to examine an urinary concretion of a horse, which, from its figure and size, was unquestionably from the kidney of that animal; for I have found by experience, that one cannot depend entirely on the accounts in cabinets, nor
indeed,

indeed, sometimes, on the assertions of persons who collect specimens.

1. This concretion, which Dr. Baillie was so good as to give me, was of a blackish colour, was very brittle and hard, and had no smell or taste. It felt heavier than human urinary calculi.

2. Under the blowpipe it became quite black, and emitted the smell, weakly, of common animal matter. It was reduced very little in quantity, and showed no appearances of fusibility, after being exposed for a considerable time to the most intense fire of the blowpipe.

3. Muriatic acid dissolved this concretion, with effervescence, yielding a clear solution; which, on evaporation to dryness, left a black and bitter residue.

4. A little of the residue (3.) being boiled in pure water, to the filtrated liquor superoxalate of potash was added; which occasioned a very turbid appearance, and copious white precipitation.

5. Nitric acid also readily dissolved this concretion, with effervescence. The solution being evaporated, partly to dryness, and partly to the consistence of an extract, the dry residuary matter was white and bitterish, and the extract-like part showed no signs of fusibility under the intensest fire of the blowpipe.

6. A little of the concretion, being triturated with lye of caustic soda, emitted no smell of ammoniac.

From these experiments it appears, that this calculus, like the former one from a rabbit, consists of carbonate of lime and common animal matter.

A renal calculus of a horse, in Mr. Hewitson's collection, appeared, on examination, to consist of carbonate of lime and common animal matter.

Another specimen, however, of renal calculus of a horse, in the same collection, marked No. 3. was found to consist of phosphate of lime, phosphate of ammoniac, and common animal matter. It was fused under the blowpipe.

The specimen marked No. 8. in the same collection, which was said to be a vesical calculus of a horse, appeared to consist of the three ingredients just mentioned.

I have met with two instances of a deposit of a prodigious quantity of matter in the urinary bladder of horses, which had not crystallized, or even concreted: it amounted, in one specimen, which was given to me by Dr. Marshall, to several pounds weight; and in the other, which is in the possession of Mr. Home, to about 45 pounds. Its composition was, principally, carbonate of lime and common animal matter*.

I have not found any instance of human urinary calculi of a similar composition to that of the rabbit, and those of horses above described, which consist of carbonate of lime and animal matter; and I believe that human urinary calculi very rarely occur of a similar composition to those of the dog and horses above mentioned, which were found to consist of phosphate of ammoniac, phosphate of lime, and animal matter, without containing *uric oxide*.

The difference in the constitution of urinary concretions may depend on the difference of the urinary organs of different animals, on the food and drink †, and on the various diseased and healthy states of the urinary organs.

I have not found the uric oxide in the urinary concretions of any phytivorous animal; but, whether it would be formed in the human animal when nourished merely by vegetable matter, must be determined by future observations. In the mean time, it is warrantable to conclude, from analogy, that it would not, and the application of this fact to practice

* Since this paper was read, Mr. Blizard has been so attentive as to send me another specimen of the same kind of deposit as those here mentioned. It now appears probable, that such deposits frequently take place, although I believe they have not been noticed before.

† I found the stomach-concretion called *oriental bezoar*, to consist merely of vegetable matter; as did the intestinal concretion of a sheep.

is obvious: but I now purposely avoid making any practical inferences, until I can, at the same time, state a number of facts I have collected, relative both to concretions and to the urine itself.

V. Short Account of the last Russian Expedition for making Discoveries in the North-east Sea. By Professor BLUMENBACH at Gottingen. From Geographische Ephemeriden. Published by Major VON ZACH, May 1798.

AS very little is yet publicly known of the great six-years expedition, undertaken by the Russians for making discoveries in the Northern Archipelago or Eastern Ocean, the following short account of it, taken from the most authentic sources, and particularly from the correspondence of Dr. C. H. Merck, who was employed in the expedition as naturalist and physician, with the Royal Academy of Sciences at Gottingen, may afford satisfaction to those fond of geographical researches.

This expedition was proposed by Catherine II. so early as the month of November 1784. A plan was also drawn up for it; and the command conferred upon Captain Billings an Englishman, then in the naval service of Russia, who had accompanied Mr. Bayly the astronomer in Cook's last voyage round the world in 1776—80. Three captains of the second rank were appointed under him, viz. Hall, Sarischef and Bering, not the son, as Lessops says, but the grandson of the celebrated Capt. Vitus Bering, who, on the 24th of December 1741, was interred on an island in the sea of Kamtschatka, named after himself, and where he had been shipwrecked.

The principal objects of this great and very expensive expedition were, to supply all the deficiencies in regard to the important discoveries with which the geography of Asiatic
Russia