FURTHER OBSERVATIONS
ON THE
PROXIMATE PRINCIPLES
OF THE
URINE.

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THE principles of which I purpose at present to speak, are lithic acid, oxalic acid, and cystic oxide; and my object will be to point out the relation of these different principles, and of urea and sugar formerly described, with the albumen of the blood. I have still doubt respecting the composition of the phosphates, and therefore postpone the consideration of them for the present.

Of Albumen. The blood of a person labouring under a slight inflammatory affection, but otherwise in good health, was the subject of experiment. The serum was separated and dried in the manner formerly described. A portion was then analysed,

with the view of ascertaining the quantity of saline and other substances present, in order that they might be allowed for*. Four grains of what was considered as pure albumen, reduced to an impalpable powder and burnt with the oxide of copper, yielded upon an average of

Water - - 2.8 grs.

Mixed Gases 17.75 cubic inches,
of which 15.65 c. i. were carbonic acid, and 2.1 c. i. azote.

Hence this quantity consists of

Hydrogen - .311

Carbon . - 1.990

Azote - - .622

2.923

Oxygen - - 1.077

4.000

which very nearly corresponds with

7 atoms hydrogen	8.75	} <small>per cent. of</small>	hydrogen	7.77
7½ atoms carbon	56.25		carbon	50.00
3 atoms oxygen	30.00		oxygen	26.66
1 atom azote	17.5		azote	15.55
	<hr/> 112.50 <hr/>			<hr/> 100.00 <hr/>

* Another portion was coagulated and well washed to remove the foreign substances. The results were very nearly the same as with the uncoagulated albumen when the proper corrections were made.

The albumen ovi yielded exactly the same results. According to MM. Gay Lussac and Thénard, the albumen ovi is composed of

Hydrogen	-	7.540
Carbon	- -	52.883
Oxygen	- -	23.872
Azote	- -	15.705

100.

results which do not differ much from the above*.

I acknowledge I did not expect to find this principle to be so simply constituted, nor in fact to be formed of definite proportions of its elements. I was led to examine it accidentally: my friend Dr. Elliotson having furnished me with the blood of a person labouring under extreme diabetes, it struck me that a comparative examination of this with healthy blood, might throw some light upon the nature of this unmanageable disease. I was induced therefore to undertake it, but with the intention principally of determining whether the quantity of azote was the same in each. The results were the following:

It may be proper to premise that the diabetic blood I examined, presented the usual appearances of healthy blood. Sometimes in this disease the

* See Recherches Physico-chimiques, ii. 332.

serum has a wheyish or milky appearance, but this has been likewise observed in other diseases, and even in the blood of healthy persons when drawn some time after a meal.

Specific gravity of the serum of diabetic	
blood	- - - - - 1029.5
_____ of the urine of the same	
person, voided at the same time	- 1044.8

100 grains of the diabetic serum evaporated and dried to the standard formerly mentioned, left 10 grains of solid matters, which, upon analysis, were found to consist of

Albumen	- - - - -	8.7
Lactates and animal matters usually		
existing in the blood	- -	.6
Salts	- - - - -	.7
		<hr/>
		10.
		<hr/>

which very nearly coincide with the proportions ascertained by Dr. Marcet and Berzelius, to exist in the serum of healthy blood *.

100 grains of the diabetic urine, evaporated and dried as before, left 11.7 grains, nearly the whole of which was sugar.

Portions of albumen from the serum of this dia-

* See Vol. II. p. 370. and Vol. III. p. 230. of the Medico-Chirurgical Transactions.

betic blood, dried and analysed as before, yielded *precisely the same results* as albumen from the serum of healthy blood.

To ascertain the relative proportions of azote present in the diabetic urinous extract and the extract from healthy urine, portions of them were burnt with the oxide of copper. The results were, that 100 parts of the diabetic extract, (abstracting alkaline and earthy salts) yielded only 6.5 parts of azote, while the same quantity of extract from healthy urine yielded from 35 to 40 parts of the same principle.

To obviate the objection that the saccharine matter of the urine might be formed from the other principles of the blood, and not from the serum, comparative experiments were made with the *crur* of healthy and of diabetic blood. The results were precisely similar as to the quantity of azote in both, and at the same time the quantity of azote did not differ much from that found to exist in the serum above mentioned.

I shall at present leave my readers to draw their own conclusions from these experiments.

Lithic acid.—I stated in my former communication that 4 grains of lithic acid yielded 16.5 cubic inches of mixed gases, of which 5.5 cubic inches were azote and 11. c. i. carbonic acid. The total

bulk of the mixed gases, 16.5 cubic inches, is very nearly correct; but misled partly by the authority of M. Gay Lussac*, and partly by my modes of measuring and estimating the proportion of atmospheric air supposed to be present in the apparatus, I overrated the proportion of azote, and consequently underrated that of carbonic acid. The correct proportions, as recently obtained in numerous experiments, appear to be

Total 16.75 c. i. of which
 4.2 c. i. is azote, and
 12.55 c. i. carbonic acid.

The quantity of water was also a little overrated in my former experiments. The correct quantity as obtained from 4 grains of absolutely pure lithic acid, procured from the excrements of the boa constrictor, is .805 grains. Four grains of lithic acid then are composed of

Hydrogen	-	-	.089
Carbon	-	-	1.595
Azote	-	-	1.245
			<hr/>
			2.929
Oxygen	-	-	1.071
			<hr/>
			4.000
			<hr/>

which very nearly correspond with

* M. Gay Lussac states, that he found the proportion of the carbon to the azote in lithic acid, to be nearly as 2 to 1. See *Annales de Chim.* xcvi. p. 53.

1 atom hydrogen	1.25	} or per cent. of	2.22 hydrogen
3 atoms carbon -	22.5		40.00 carbon
$1\frac{1}{2}$ atoms oxygen	15.0		26.66 oxygen
1 atom azote -	17.5		31.11 azote
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	56.25		100.00
	<hr/>		<hr/>

I was led to repeat my experiments on lithic acid, from a certain want of analogy between the results I formerly obtained, and the composition of other substances existing in the urine. And I may here observe, once for all, that a more extensive experience in the analysis of organic substances has made me acquainted with various circumstances which I never suspected, and which are of the utmost importance in this most difficult department of practical chemistry. Even yet I have not surmounted all the difficulties, so as to be able to succeed beyond a doubt in any one given experiment. A circumstance, which, by rendering numerous repetitions of the same experiment necessary, has made the present investigation exceedingly laborious.

Oxalic acid.—This acid is a constituent of that most distressing and refractory species of calculus, commonly called *mulberry* calculus. Various attempts have been made by different chemists to analyse this acid; but if we may guess from their apparently discordant results, without

success. For a very long time I could make nothing of it, but by degrees, as the composition of other organic substances became known, the nature of this also began to be developed, and at length I flatter myself that I have succeeded in ascertaining its composition.

Four grains of this acid in its crystallized state uniformly yield very nearly 6.3 cubic inches of carbonic acid gas, and 1.65 grains of water; results which I obtained from the commencement of my experiments, but which I could not reconcile with the doctrines of the atomic theory then generally received. From these results it appears that four grains of this acid consist of

Hydrogen	.183
Carbon	-.800
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	.983
Oxygen	3.017
	<hr/>
	4.000

which correspond almost exactly with

4 atoms hydrogen	5.	} or per cent. of {	4.44
3 atoms carbon	22.5		20.00
8½ atoms oxygen	85.		75.55
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	112.5		100.00
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The above results being all that are necessary for my present purpose, I shall take another opportunity of reconciling my analysis with those of others, as this, from its being a mere chemical question, would, I conceive, be misplaced here.

Cystic oxide.—For an opportunity of submitting this rare species of calculus to an analysis, I am indebted to Dr. Marcet.

Four grains of this substance rendered as pure as possible, and allowance being made for the earthy salts mixed with it, yielded upon an average of

Mixed gases 11 cubic inches, of which
 1.6 c. i. was azote,
 9.4 c. i. were carbonic acid,
 and 1.85 grains water.

Hence this quantity consists of

Hydrogen	.205
Carbon	1.195
Azote	- .474
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	1.874
Oxygen	2.126
	<hr/>
	4.000

which almost precisely correspond with

3 atoms hydrogen	3.75	} or per cent. of	5.00
3 atoms carbon	22.5		30.00
4 atoms oxygen	40		53.33
$\frac{1}{2}$ atom azote	8.75		11.66
	<hr/> 75.		<hr/> 100.

Purpuric acid.—It was my intention to have stated here the analysis of this curious principle, but my stock, which was originally small, has been quite exhausted, without my being able to satisfy myself of its exact composition. The analysis I gave in the last volume of the Transactions of the Royal Society, was made on very small portions of the acid, and many times repeated with the same results. It consequently appeared to me at the time to be correct, but from what I have since observed, I have some doubts upon the subject. I postpone, therefore, the further consideration of this principle, till I have an opportunity of verifying my conjectures.

Pink sediment.—Some time ago I examined two or three specimens of this substance, which, as is well known, is deposited from the urine of those labouring under febrile and inflammatory diseases. In every instance I found distinct traces of *nitric acid*. The method adopted to discover this was to digest a little pure barytes with the sediment. The nitrate of barytes thus formed was of course

soluble, while the other compounds were mostly insoluble. Sulphate of potash was now added, and the nitrate of potash obtained was in one instance procured in the state of crystals, and in all the others rendered distinctly perceptible by its mode of combustion with paper and other substances containing carbon.

Sediments of a very different nature are often confounded under the name of *pink* and *lateritious* sediments; hence, probably, many of them do not contain nitric acid. One of those I examined was from a gouty subject, and was deposited after a slight febrile attack. Its colour was a deep *brick red*. The others were also deposited during febrile attacks, but not from the urine of gouty subjects; their colour was lighter and more approaching a *pink*; and in these the nitric acid appeared less abundant.

I do not know the exact composition of those pink sediments into which nitric acid enters as a constituent, but they appear to be composed of lithic, nitric, and purpuric acids, united to some base, perhaps ammonia or soda, and not to owe their properties to a distinct acid principle (the *rosacic* acid) as maintained by M. Proust, at least I never could obtain any satisfactory evidence of the existence of such an acid. If the above view be admitted, it may be probably explained by supposing that the nitric and lithic acids are se-

creted together, and that the purpuric acid, or rather the purpurate of ammonia on which the colour depends, is formed by the action of the nitric upon the lithic acid in the usual manner.

I shall conclude for the present, with the following tabular view of the results*.

100 parts contain	Hydrogen.	Carbon.	Oxygen.	Azote.	Weight of atom.	Sugar being 1.
Sugar	6.66	40.00	53.33	—	18.75	1
Urea	6.66	20.00	26.66	46.66	37.5	2
Lithic Acid...	2.22	40.00	26.66	31.11	56.25	3
Cystic Oxide	5.00	30.00	53.33	11.66	75.00	4
Oxalic Acid .	4.44	20.00	75.55	—	112.5	6
Albumen.....	7.77	50.00	26.66	15.55	112.5	6

It would be premature in the present state of this investigation, to attempt to draw any conclusions from the above experiments. I cannot, however, dismiss the subject, without directing the attention of my readers to the extraordinary relations

* I wish to remark here, that the numbers representing the weights of the atoms may be placed very differently according as different views are taken of the subject. I have not yet fully made up my mind upon this part of the inquiry, but have placed the numbers in the above order, that the extraordinary relation existing among them might be more conspicuous, and because this arrangement, in the present state of our knowledge, is as good as any other.

that exist among the above numbers, and observing that I am engaged in the investigation of the laws which they obey—laws which appear to regulate not only the operations of the animal economy, but the whole material world.