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ON THE PROPORTION
OF
U R E A
IN CERTAIN DISEASED FLUIDS.

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THE existence of urea in the blood, in several forms of disease, has long ceased to be a matter of doubt in the minds of chemists. I am not aware, however, that the *proportion* in which that substance exists in morbid blood or secretions, has yet been very accurately determined. In attempting to throw some light on this subject, I have at different times examined fluids obtained from patients at Guy's Hospital; and now have the advantage of being able to refer to Dr. Bright's report of two of those cases, from the subjects of which I obtained, through his kindness, the specimens for analysis. Before relating the results of my examinations, I wish to describe the method which I have adopted in order to separate the urea perfectly free from contamination, and at the same time to avoid that loss which is inevitable when obtaining that substance for estimation in the form of nitrate.

Those who are accustomed to the manipulations of animal chemistry will at once recollect the uncertainty they have felt, as to whether the whole of the urea were separated by nitric acid from the mother liquor; and how tedious and unsatisfactory have been the subsequent processes of evaporation, to crystallize the remaining nitrate.

The relation of urea to ozmazome, as regards solubility in various menstrua, has rendered its separation from that substance a matter of great difficulty; and there is every reason to believe, that when nitrate of urea crystallizes from the extractive matter, its weight is much increased, by an

unavoidable adherence of the latter principle. I am quite satisfied in my own mind that this cause of increased weight in our results greatly outbalances any loss which occurs by the imperfect crystallization of the nitrate before alluded to; for by the more perfect method which I now employ, I have always obtained a far less proportion of urea than formerly, although the risk of losing any of the principle present is not nearly so great as that incurred by the usual process.

The delicacy of the plan I now adopt is very great; so much so, that urea can be obtained perfectly pure from an animal fluid, which contains it in the proportion only of 0.15 per mille. The analysis is performed as follows:—The serum, or effused fluid, is evaporated to dryness, at a heat sustained somewhat below 212° Fahrenheit; the dry mass is broken up; boiling water thrown upon it, and allowed to digest several hours. This liquor being carefully poured off, a second portion of water is added, and allowed to digest; after which, the whole is thrown on a filter, and the solid matters washed with distilled water till the percolating fluid ceases to effect a solution of nitrate of silver. The digested and filtered liquors are next evaporated to dryness, by a gentle heat; and the extract, so obtained, digested in a stopper-bottle, with common ether of the shops, of sp. grav. 0.754. This menstruum extracts the urea only; and by digesting successive portions of it until the last added yields no deposit of that principle on evaporation, we obtain the whole of the urea present, and thus directly estimate its weight. As obtained by this process, urea is quite pure and colourless. It once happened to me to observe some slight contamination of the urea, obtained as above, by fatty matter which had escaped separation with the albumen: this, however, was easily got rid of, by dissolving the urea in distilled water, and throwing the solution on a filter previously moistened, when the fatty matter remained behind, and allowed the urea to pass through, perfectly pure.

The first fluid which I shall mention, as examined by this process, was obtained from John Gillmore, Dec. 18, 1839, a case of albuminuria. It was an effusion on the brain, and 210.4 grs. were obtained for examination. From this quan-

tity 0.05 gr. of urea was obtained, equal to about 0.415 per mille. This fluid yielded but slight traces of albumen.

The second case, from which I obtained the serum of the blood, and likewise a portion of fluid which was procured from the cellular tissue by making punctures in the scrotum, was that of John Wiseman, a boy in Job's Ward, under the care of Dr. Bright*. The serum of this patient was of sp. gr. 1015, and contained only 23.49 gr. of albumen in 500 grs.; whereas the same quantity of healthy serum affords about 39.75 grs. It contained 0.2096 per mille of urea. The fluid obtained from the scrotum was of sp. gr. 1007.9: the analysis of 500 parts gave,

Water	492.400
Albumen	0.800
Extractives and Salts.	6.725
Urea	0.075
	500.000

the proportion of urea being equal to 0.150 per mille.

The third case, from which I obtained the serum of the blood at two different times, and also the fluid effused into the pericardium, was that of Susan Smalling, a patient of Dr. Bright†.

The first specimen of blood was received on March 4th. The specific gravity of its serum was 1025, being somewhat lower than natural: the analysis of 500 grs. yielded,

Water	452.10
Albumen	32.50
Extractives and Salts	15.15
Urea	0.25
	500.00

We here observe a deficiency of albumen, an increase of extractives and salts, and the presence of an ingredient foreign to the serum. The second specimen of blood which I received from this patient was obtained by cupping; and

* Vide No. 8 of Dr. Bright's Cases, Guy's Hospital Reports, No. X.

† Vide No. 21 of the same Cases, *ibid.*

not from the arm, as was the case with all the previously-mentioned specimens. It was sent to me on the 30th of April. The specific gravity of its serum was then 1029, or natural: the analysis of 500 parts was as follows:—

Water	448.3
Albumen	40.8
Extractives and Salts	10.65
Urea	0.25
	500.00

The effusion into the pericardium of this patient was of sp. grav. 1028. It yielded urea, but only a trace in 500 grs. of the effusion.

It will be observed, from the analysis quoted above, that the largest proportion of urea which I have detected in the blood is 0.5 per mille, and the least 0.2096. The effusion on the brain gave 0.415; the fluid effused into the cellular tissue of the scrotum, 0.150 per mille; and the pericardial fluid merely a trace in 500 grains.

The condition of the blood in the patient Susan Smalling is worthy of consideration, inasmuch as the serum of the blood underwent a great change between the dates of March 4th and April 30th: it being sp. grav. 1025 on the former, and 1029 sp. grav. on the latter date: the proportion of urea, however, remaining the same. The serum of the 30th April, if we except the existence of urea, may be considered as normal; the albumen being present quite to the natural extent; indeed, if any thing, somewhat beyond the amount generally found in the serum of healthy blood.

The case from which the scrotal fluid was obtained, affords an instance of great decrease in the specific gravity of the serum of the blood. The lowest specific gravity mentioned by Dr. Christison, in his lately-published valuable work, is 1019: this specimen was, however, only 1015 sp. gr.

Feeling great confidence as to the delicacy of the process which I have described as applicable to the detection of urea, I was anxious to apply it to the examination of the serum of healthy blood, which, by some authorities, has been stated to contain urea. Before the present method of

analysis occurred to me, I had examined the serum of healthy venous blood without being able to detect urea in it. I determined, however, to examine the serum of healthy arterial blood by this new method, in order more completely to satisfy my mind on the subject. For this purpose, serum was obtained from blood drawn from the temporal artery, and submitted to the new process, but no evidence of the presence of urea could be obtained; though I know, from previous experiments, that I could not have failed to detect it, had it existed even in so small a proportion as 0.2096 per mille.