there is wheezing, the “*râle sibilant*” of Laennec, and generally heard loudest under the clavicles; and that the existence of these two species explain the difference of opinion which has existed on the treatment of Catarrh.

Should these few observations on a point of practical medicine be found suitable for a Journal to which I earnestly wish the best success, I shall again intrude upon its pages. Had I known at an earlier date of the forthcoming of an Irish Periodical, I might have had a better offering to present.

ART. IV.—*On the Composition of the Urine and Blood in Diabetes Mellitus.* By ROBERT J. KANE, M. R. I. A.,
Professor of Chemistry to Apothecaries' Hall.

THERE are few instances among the morbid states of the living system in which the application of chemistry to the medical sciences, is more direct, and its utility more obvious, than where, as in diabetes, the nature of a disease, and consequently its treatment, is to be determined by the composition of a pathologic product; a question evidently to be resolved by chemistry alone.

When we consider the present most generally received opinion as to the nature of this disease, we see that it is derived totally from the ideas of the composition of the urine and of the blood; a large quantity of a principle eminently vegetable, and containing no azote, makes its appearance in the urine, and its formation is accompanied by a corresponding diminution in quantity, of the most highly animalized principle (urea) with which we are acquainted. There takes place a de-animalization of the whole system: and in cases which terminate favourably, as the quantity of the morbid product (sugar) diminishes, the

urine is brought back to its natural condition by the re-appearance of the proper quantity of urea, and thus these two principles, one of which contains half its weight of nitrogen whilst the other contains none, alternate in quantity, and, to use the words of Prout, the latest and best informed writer on the subject, their alternation constitutes one of the most remarkable facts in medicine with which we are acquainted.

During the spring and summer of 1831, while engaged in a series of analyses of diabetic urine, which formed a part of the duties of clinical clerk to the Meath Hospital, I accidentally observed some phenomena, which rendered it probable that the quantity of urea in diabetic urine, is not so small as is generally considered, and finally led me to the conclusion, that in this disease the urea is not at all diminished in quantity, but that a man secretes in a given time as much of that principle while dying of the most severe saccharine diabetes, as he does in a state of the most perfect health.

The circumstances which led me to the examination of the subject were as follow: it was customary, in order to determine the presence or absence of urea, to add to the urine concentrated to a sirupy consistence, some nitric acid: the solution became dark-coloured, and after some minutes some few crystals of the acid nitrate of urea of a brown colour were usually deposited. One day, after adding the acid, the solution remained clear and almost completely solidified from the deposition of white nitrate of urea; this effect, however, was only momentary, and after some minutes, the liquor became dark, a few bubbles of gas were disengaged, and the whole of the crystals disappeared. The solution then exactly resembled those which had always before resulted from the action of the nitric acid on the diabetic urine.

So remarkable a circumstance induced me to try whe-

ther a larger quantity of urea could be obtained than that usually gotten, and to endeavour to find out by what reaction of the acid on the principles existent in the urine, the deposition of the nitrate of urea under a crystalline form was prevented.

I evaporated equal volumes of healthy urine, Sp. Gr 1027.5, and of diabetic urine 1037, and added nitric acid to each; in the one a copious deposition of crystals took place, but in the other none. The colour of the healthy urine was however scarcely changed, whilst that of the diabetic urine originally paler, became dark reddish brown, and its temperature was sensibly augmented; there was effected therefore between the diabetic urine and the acid, some process of decomposition.

To avoid this, the experiment was varied thus:—the nitric acid was diluted with its own volume of water, and mixed with the diabetic urine in a phial, which was instantly immersed in a mixture of snow and salt; the process was successful, the colour of the mixture remained pale, and a copious crystallization of nitrate of urea crowned my most ardent hopes.

To ascertain whether the presence of the sugar was sufficiently powerful to prevent the formation of nitrate of urea, the following experiment was made.

To 1000 grains of healthy urine, Sp. Gr. 1027.5, 30 grains of sugar were added, and a similar quantity of the same urine taken pure. To each, after evaporation, was added the same quantity of nitric acid, the usual crystallization took place in the non-saccharine urine, but that which contained the sugar became dark-coloured, and but a very trivial quantity of nitrate of urea was obtained from it.

The nature of the products arising from the decomposition of the urea, was not particularly examined, as they did not appear of any pathologic interest. The solution contains much ammonia, and probably cyanic and oxalic

acids. Want of time precluded me from investigating the subject more minutely.

Called from the clerkship of the Meath Hospital, to the chair of Chemistry at Apothecaries'-hall, just at the moment when I had satisfied myself as to the fact, and obliged to commence immediately a course of lectures, I could not devote to the subsequent analyses, time sufficient for the estimation of the relative quantities of all the ingredients of the urine. As far as I could, however, I effected the insulation of the more important principles, the sugar, urea, and, where it existed, the albumen, and their quantities, taken from the whole solid matter, gives the quantities of the other animal substances, together with the salts. For the opportunities which were granted to me to make those researches, I take this occasion of returning my thanks to Drs. Graves and Stokes, the Physicians to that Hospital, who, real lovers of wisdom, take every opportunity of forwarding the progress of science in all its branches.

In the subsequent analyses, the method pursued was as follows:—a given quantity of the urine was desiccated cautiously as long as it lost weight, retaining the temperature constantly below 212° , the residue gave the relative proportions of water and of solid matter in the urine. To determine the quantity of sugar, an excess of solution of acetate of lead was added to the urine, and the precipitate separated by the filter. The lead in the filtered liquor was then thrown down by sulphuretted hydrogen, and the sulphuret of lead having been separated by the filter, the liquor was evaporated on a water bath to dryness, and the residue weighed; in some instances the confused crystalline mass was dissolved in spirit, and crystallized, but this part of the process was not found necessary.

The quantity of urea was determined by the process by means of which it had been first obtained in quantity; the mixture of acid and urine was immersed in a freezing

bath, and the nitrate of urea deposited, separated, dried, and weighed, and the quantity of urea calculated from its known composition. The nitrate thus obtained, is slightly tinged, but being weighed in this state, it gave a closer approximation to the truth than if it had been purified and decolorized; in which case, a portion of it would infallibly have been lost. The quantities of urea given, are those actually found, and I consider that they are less than actually existed in the urine, as I only succeeded in diminishing very much the action of the acid on that principle, without, however, by any means putting a total stop to its exertion.

I think it probable, that the uric acid not having been found in diabetic urine, depends merely upon the great state of dilution of that fluid, and on the small quantity in which that animal acid exists even in healthy urine. Some trials which I made in order to isolate it, were not successful; want of time prevented me from determining the relative proportions of the different salts, but they certainly exist in the natural proportions, as their total quantity is diminished merely in consequence of the dilution of the urine.

The following are the results of the analyses of diabetic urine, performed on those principles :

A man in the Meath Hospital, April 20th, 1831.

Urine, Sp. Gr., 1032.	
Water, - - - -	929
Sugar, - - - -	47
Urea, - - - -	9
Salts, Uric Acid, &c., 13	
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Mackay, a patient in Sir Patrick's Dunn's Hospital, clinique of Dr. Leahy, who kindly allowed me to examine the blood and urine :

Urine, Sp. Gr., 1030.25.

Water,	-	-	-	-	942.75
Sugar,	-	-	-	-	31.5
Urea,	-	-	-	-	9.5
Salts, Uric Acid, &c.,					16.25
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					1000.00
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A man in the Meath Hospital, May 6th, 1831.

Urine, Sp. Gr., 1036.25.

Water,	-	-	-	-	913
Sugar,	-	-	-	-	60
Urea,	-	-	-	-	6.5
Salts, &c.,	-	-			20
					<hr/>
					1000
					<hr/>

A man in Sir Patrick Dunn's Hospital, clinique of Dr. Graves :

Urine, Sp. Gr., 1033.

Water,	-	-	-	-	929
Sugar,	-	-	-	-	51
Urea,	-	-	-	-	5.3
Salts, &c.,	-	-	-		14.7
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					1000
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A man in the Meath Hospital, May 27th, 1831.

Urine, Sp. Gr., 1050.5.

Water, - - - - -	880.5
Sugar, - - - - -	70
Urea, - - - - -	13.5
Albumen, - - - - -	3
Salts, &c., and loss, -	33

1000 *

From these results, it is evident that the idea of this disease, consisting in a conversion of urea into sugar, is untenable, and that the secretion of that vegetable principle goes on without influencing in any degree the secretion of the other constituents of the urine, at the same time, the quantity of fluid taken in, increases very much the volume of the urine passed, and of course, reduces considerably the quantities of the normal constituents of the urine in any given weight of that secretion. This circumstance, coupled with the difficulty of protecting those easily alterable principles from the action of the bodies we use in such analyses, has been the cause of diabetes being considered to have as its pathognomic character, a diminution in quantity of urea, and an excessive secretion of sugar; those two principles alternating in their quantities, and albumen appearing in the urine as an intermediate step in the chain of organization, when the sugar was changing back to urea, on the recovery of the patient, or when the urea was degenerating into sugar, if the disease was on the increase; while, in fact, allowing for the dilution, the urea, salts, and probably uric acid, exist in the healthy proportions, and the secretion of the sugar is a lesion of that function, perfectly primary and independant.

* This man made but ten pints of urine in the day, at the time of the analysis, which accounts for the great degree of concentration of the urine.

Having, in three of the cases which afforded me the opportunity of studying the composition of the urine, obtained a sufficient quantity of blood to enable me to perform a pretty accurate quantitative analysis of that fluid, I endeavoured to satisfy myself as to that subject which has given rise to such contrariety of opinion among chemists, viz. the presence or absence of sugar in the blood of persons affected with this disease.

Being unable to devote but a comparatively small portion of my time to these researches, I was obliged to omit the quantitative estimation of the various saline matters; this, however, I consider but of little importance, as it is very improbable that these substances play a very important part in the phenomena of diabetes.

The analyses were conducted so as to determine two points, 1st, the existence or not of sugar in the blood; and 2nd, the relative quantities of water, oxide of iron, and the organized principles, as albumen, fibrine, hematosine, and the phosphuretted fats (cerebrine of Vauquelin).

In order to find the sugar, if any had existed in the blood, the serum was carefully evaporated to dryness, and the residue digested at a temperature = 100° F. in alcohol, sp. gr. ,830 for an hour. The alcoholic solution, which was of a very pale yellow colour, was then distilled to one-half, when a few flocculi of the white phosphuretted fat of Denis were deposited, which were removed by filtration. The clear liquor was then evaporated gradually, and frequently allowed to cool and deposit crystals, until the whole was evaporated to dryness. During these repeated evaporations and refrigerations, successive drops of saline matters, principally common salt, were obtained, deeply coloured yellow by osmazome, and mixed with a trace of fatty matter; no sugar could be by any means discovered; the saline crystals, however, were coloured yellow by the animal matter, from which it required a second crystallization to free them, and owing

to which they yielded by the action of nitric acid traces of oxalic acid; their taste, however, and their purification by re-crystallization would totally prevent any person from mistaking them for sugar. To estimate the utility of this process, five grains of sugar dissolved in a little water were mixed with a pound of blood, previous to coagulation, and were afterwards readily discovered in the serum by following it.

To fulfil the second object of the analysis, viz. the quantitative estimation of the different organized principles, the mode of analysis adopted by Denis, was followed, which renders it unnecessary to go at length into the details of so complicated a process. The quantity of blood operated on was in no case less than eight ounces, three quantitative analyses were made, the results of two of which are here given. In the report of the third in the laboratory book, the quantity of fibrine is not mentioned, which prevents me from inserting it here, although the quantities of all the other principles coincided with those in the other analyses, and I perfectly recollect that the fibrine in this case did not deviate from its usual range.

A man in the Meath Hospital, clinique of Dr. Graves.

Sp. Gr. of Serum 1030.

The blood was composed of

Water	-	-	-	-	798.13
Fibrine	-	-	-	-	2.18
Hematosine	-	-			114.50
Per-oxide of iron	-				.45
Albumen	-	-	-		50.13
Phosphuretted fat					1.70
Osmazome, Salts and					
loss	-	-	-	-	33.21

1000.

Mackey, Sir Patrick Dunn's Hospital.

Specific Gravity of Serum 1029.75

Water	-	-	-	-	781.0
Fibrine	-	-	-	-	2.9
Hematosine	-	-			130.4
Per-oxide of iron	-				.56
Albumen	-	-	-		45.5
Phosphuretted fat					2.0
Osmazome, Salts and					
loss	-	-	-	-	37.64
					<hr/>
					1000.00

The results of these analyses shew that in Diabetes, the relative proportions of the organic principles remain quite within the limits of the composition of the blood in perfect health. In fact, the blood cannot, as far as these experiments go, be considered as at all affected in this distressing malady. With regard to the non-existence of sugar, it is in opposition to a physiological principle, to the general truth of which I myself fully subscribe, that secretion is merely a kind of elective transudation, and that the substances secreted, all existed previously formed, and ready for separation, in the blood; our negative results should therefore stimulate us to seek after more perfect instruments of research, and more accurate methods of analysis, for we are as yet merely at the entrance of the applications of chemistry to medicine, and have before us a field capable, I doubt not, of immensely valuable practical application, if we can only improve our instruments and processes so as to insure its proper cultivation.