

XXXII. *Contributions to the Chemistry of the Urine.*—Paper IV.*On so-called Chylous Urine.*

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URINE white from the suspension of a quantity of fatty matter in it, has been called chylous urine, and the albumen and fibrin which escape from the blood with the fat have been considered to belong to the chyle and not to the blood.

An opportunity of observing a case of this disease having occurred to me, I was led to make the following experiments. The conclusions therefrom are,—

1st. That the fat on which the white colour of the urine depends does indeed appear in the urine after the chyle is absorbed, but the albumen, fibrin, blood-globules and alkaline salts, may be found in the urine previous to any food being taken, and these substances can be made to appear in, or disappear from the urine according as the circulation is hurried by motion or quieted by rest.

2nd. That the disease consists in some slight alteration in the structure of the kidney, by which, when the circulation is most active, one or more of the constituents of the blood passing through the filter escape from the vessels into the urine.

The supposition that the disease consists in an accumulation of fat in the blood which is thrown out by the kidneys carrying with it albumen, fibrin, blood-globules and salts, is altogether disproved, both by actual analysis of the blood itself, and by the frequent occurrence of a large jelly-like coagulum in the urine, when no white fatty matter can be seen to be present.

For an account of the patient and for the treatment and its ultimate effect in stopping the escape of the white water, which he had passed more or less frequently for nine months previous to my seeing him, I must refer to the *Medico-Chirurgical Transactions* for 1850.

On the 19th of October he came to me, having taken food last at 11 A.M. The water passed at 2 P.M. solidified like blanc mange in ten minutes. It contained, when passed from the bladder, some clots ready-formed. It was very feebly acid to test-paper. Thrown on a filter, a very small quantity of reddish streaked fibrin remained on it. The filtered fluid, at 60° FAHR., had a specific gravity = 1015. It coagulated by heat and acid. In appearance it was quite milky, but became clear when agitated with a considerable excess of ether. Some perfectly healthy blood-globules were seen with the microscope, and the granules of fat were so small as scarcely to be resolvable by a high power.

574·0 grs. of urine evaporated *in vacuo* over sulphuric acid.

Residue = 25·5 grs.

= 44·42 grs. per 1000 grs. of urine.

Burnt. The ash = 4·60 grs. = 8·01 grs. per 1000 grs. of urine.

1015·4 grs. of urine precipitated with more than twice their bulk of alcohol.

Albumen and fat = 22·75 grs. = 22·40 grs. per 1000 grs. of urine.

Treated with ether. Residue soluble in ether.

= 8·5 grs. fat = 8·37 grs. per 1000 grs. of urine.

Albumen = 14·03 grs. per 1000 grs. of urine.

574 grs. treated with absolute alcohol after evaporation to dryness.

Alcohol filtered when cold.

Residue . . . = 9·02 grs. = 15·70 grs. per 1000 grs. of urine.

Burnt ash . . = 1·40 gr. = 2·44 grs. per 1000 grs. of urine.

Urea and extractive . . . = 13·26 grs. per 1000 grs. of urine.

Hence

Total residue . = 44·42 grs. per 1000 grs. urine. Specific gravity = 1015.

Total ash . . = 8·01 grs.

Albumen . . = 14·03 grs.

Fat = 8·37 grs.

Urea, &c. . . = 13·26 grs.

Loss . . . = 75 gr.

Water . . . = 955·58 grs.

1000·00 grs.

In order to watch the variations in the appearance of the urine at different hours of the day, it was each time passed into a bottle, marked with the hour at which it was made for five successive days.

First day. Water passed at

7 A.M. thrown away. Breakfast a pint of coffee; a quarter of a pint of milk.

Bread, with little butter or sugar.

8^h 10^m A.M., just before breakfast. Quantity one ounce, clear. Acid with pink deposit of urate of ammonia gave no precipitate with heat and nitric acid. Remained acid three days.

10 A.M. Reddish colour, milky throughout. Six ounces alkaline, in three days.

12^h 20^m. Milky, thick throughout. Six ounces, alkaline; contained some clots of fibrin.

1^h 25^m P.M. More thick. White with rather reddish clots, two ounces, alkaline, made just before dinner, which consisted of mutton chop, boiled rice, onion with bread.

2^h 20^m P.M. White, with more blood, six ounces, alkaline.

6 P.M. More white, with deposit of blood, eight ounces, alkaline; smelt strongly

of onions ; passed just before tea ; three quarters of a pint of cocoa with milk and bread.

10 P.M. Very white, milky, with some blood. Twelve ounces, alkaline.

Second day. Water passed at

7 A.M. Lost.

8^h 30^m A.M. Nearly clear ; a little blood and very slight coagulum. An ounce and a half, acid ; passed just before breakfast. Pint of boiled milk with sago, bread, and a little butter.

9^h 30^m A.M. Very slightly opalescent, with a delicate transparent coagulum filling the lower half of the bottle, containing some streaks of blood. The clear liquid coagulated strongly with heat and acid. An ounce and a half in quantity, alkaline.

11^h 30^m A.M. Milky, with a little blood, alkaline.

1^h 15^m P.M. Milky, with more blood ; six ounces more alkaline ; made just before dinner, which consisted of a mutton chop, broccoli and bread.

3 P.M. Milky ; about eight ounces, alkaline.

5 P.M. Milky ; eight ounces, feebly acid ; passed just before tea ; three quarters of a pint of milk and sago, bread, very little butter.

8 P.M. Milky ; eight ounces, feebly acid.

10^h 30^m P.M. Milky ; eight ounces, slightly more acid.

Third day. Water passed at

6 A.M. Opalescent yellow, did not clear with heat ; gave the slightest trace of albumen with heat and acid ; about eight ounces, slightly acid.

7^h 30^m A.M. Clear when passed ; cloudy about twelve from urate of ammonia ; about one ounce passed immediately after getting out of bed ; gave a more distinct trace of albumen, contained a few blood-globules ; slightly acid.

8^h 30^m A.M. The whole of the urine in the bottle consisted of coagulum of a yellow opalescent colour, not at all milky ; a few drops of liquid only could be poured from it, and this was excessively albuminous ; the quantity made was nearly two ounces, alkaline to test-paper, passed just *before* breakfast, which consisted of a pint of boiled milk and sago, bread, and a little butter.

9^h 30^m A.M. More opalescent ; slightly milky, with a tinge of blood ; the bottle was full of coagulum from which a drachm or two of liquid could be poured ; about five ounces ; alkaline highly.

12^h 30^m A.M. Milky ; eight ounces, neutral.

1^h 15^m P.M. Milky ; two ounces, neutral ; passed just before dinner ; steak, roast onion and bread.

4^h 45^m P.M. Milky ; five ounces, neutral.

5^h 30^m P.M. Milky ; five ounces, alkaline just before tea ; three quarters of a pint of coffee, bread, with little butter.

9^h 30^m P.M. Milky ; eight ounces, neutral.

10^h 30^m P.M. Milky ; four ounces, feebly acid.

Fourth day. Water passed at

6 A.M. Clear, six ounces, strongly acid; the slightest trace of albumen with heat and acid.

7^h 15^m A.M. Clear; half an ounce, very strongly acid. Passed immediately on getting out of bed for the day; the slightest trace of albumen with heat and acid. This and a little of the urine passed at six, had specific gravity 1027, 513.5 grs. precipitate with alcohol = 0.40 gr. = 0.8 gr. per 1000 grs. of urine.

9^h 50^m A.M. Slightly opalescent, solid, yellow, coagulum; three ounces, alkaline. Passed just *before* breakfast. Pint of boiled milk with sago and bread, with but little butter or sugar. When filtered a bloody coagulum remained on the filter. The clear liquid left at rest deposited a layer of blood-globules. Specific gravity = 1015.6, gave a nearly solid coagulum with heat and acid. 507.8 grs. precipitated by alcohol = 7.20 grs. = 14.1 grs. per 1000 grs. of urine.

11 A.M. Chylous with clots and pink coagulum; six ounces, alkaline, filtered; bloody coagulum was left on the filter. Milky fluid on standing deposited a layer of blood-globules. Specific gravity = 1013.4, 506.7 grs. precipitated by alcohol = 7.35 grs. = 14.5 grs. per 1000 grs. of urine.

1^h 35^m P.M. Very milky; eight ounces, with little blood; neutral. Passed just before dinner; mutton chop with broccoli and bread.

3^h 40^m P.M. Very milky; eight ounces, very little blood; neutral.

5^h 40^m P.M. Very milky; one and a half ounce; blood doubtful; feebly acid; passed just before tea; three quarters of a pint of coffee, half a pint of milk with bread, but little butter or sugar.

7^h 40^m P.M. Very milky; four and a half ounces; little blood; neutral.

10 P.M. Very milky; five ounces; little blood; very feebly acid.

Fifth day. Water passed at

6 A.M. Slightly milky; yellowish; eight ounces; strongly acid. Specific gravity = 1017. No blood; contained a very minute trace of albumen; did not clear with heat.

8^h 15^m A.M. Slightly cloudy; no blood; no coagulum; one and a half ounce, acid. Specific gravity = 1020.7. Contained a considerable quantity of albumen, though he had nothing to eat and remained in bed.

9^h 30^m A.M. Almost quite clear; three quarters of an ounce, acid. Passed just before breakfast, which consisted of a pint of boiled milk, sago, bread, with a little butter. Apparently rather less albumen. Specific gravity = 1022.

11^h 20^m A.M. Yellowish milky. Three ounces made just before he got up for the day; very feebly acid. Contained a considerable quantity of albumen; more than the two preceding specimens. No spontaneous coagulation. Did not clear by heat. Specific gravity = 1019.4.

1 P.M. Milky; coagulated spontaneously; four ounces, neutral; passed just before dinner; mutton chop, onion with bread.

4^h 50^m P.M. Milky; neutral; six ounces just before tea; three quarters of a pint of milk boiled, bread with butter.

8 P.M. Milky; five ounces; neutral.

10 P.M. Milky; three ounces; feebly acid.

Sixth day. Water passed at

6^h 35^m A.M. Yellow milky; more than opalescent; six ounces, strongly acid. Specific gravity 1026·6. Passed on getting up. 513·3 grs. precipitated by alcohol = 1·85 gr. = 3·6 grs. per 1000 grs. of urine.

8^h 10^m A.M. More milky, with large pinkish coagula; two ounces, alkaline. Specific gravity 1016·4. 508·2 grs. precipitated by alcohol = 8·40 grs. = 16·5 grs. per 1000 grs. of urine.

9 A.M. Pink coagulum filling an ounce bottle, alkaline; passed just before breakfast; a pint of boiled milk, sago, with a little butter.

11^h 30^m A.M. Very milky, with large coagula.

From these observations, and more particularly from the 3rd, 4th and 6th days, it is evident that the fibrin and albumen appear in the urine when no fat is perceptible, and previous to breakfast being taken, thus:—

The 3rd day, 8^h 30^m A.M., the urine passed before breakfast, after he had been up an hour, was highly albuminous, and a nearly solid coagulum filled the bottle.

The 4th day, 7^h 15^m A.M., on first getting up the urine contained the slightest trace of albumen. The specific gravity = 1027. The precipitate by alcohol = 0·8 gr. per 1000 grs. of urine.

The 4th day, 9^h 50^m A.M., just before breakfast the urine formed a solid coagulum, and contained a visible deposit of blood. Specific gravity = 1015·6. The precipitate by alcohol = 14·1 grs. per 1000 grs. of urine.

The 4th day, 11 A.M., the urine was chylous.

The 6th day, 6^h 35^m A.M., on first getting up, the specific gravity = 1026·6. The precipitate by alcohol = 3·6 grs. per 1000 grs. of urine.

The 6th day, 8^h 10^m A.M., before breakfast the urine coagulated spontaneously. Specific gravity = 1016·4. The precipitate by alcohol = 16·5 per 1000 grs. of urine.

Further experiments on the influence of rest and motion in lessening or increasing the albumen in the urine, previous to breakfast, were then made.

On the Influence of Rest and Motion in Lessening or Increasing the Albumen in the Urine previous to and after Food was taken.

Seventh day. Last food was taken at 5^h 15^m P.M. yesterday. He laid in bed this morning till 9^h 30^m A.M.

Urine passed at

10 P.M. Last night, milky; eight ounces.

6^h 40^m A.M. Yellow, slightly milky; six ounces, acid; contained a little albumen.

8^h 10^m A.M. Clear, healthy looking urine, made just before breakfast (boiled milk, a pint of sago, bread, with a little butter). The quantity, one and a half ounce.

Specific gravity = 1021.3. Gave no coagulum with heat and acid. 510.65 grs. precipitated by alcohol. Precipitate = 0.30 gr. = 0.6 gr. per 1000 grs. of urine.
 9^h 30^m A.M. Opalescent, no spontaneous coagulation. Two and a half ounces passed when he got up. Specific gravity = 1019.0. Gave a considerable precipitate with heat and acid. 509.5 grs. precipitated by alcohol. Precipitate = 1.40 gr. = 2.7 grs. per 1000 grs. of urine.

12^h 30^m A.M. Milky; spontaneously coagulating.

Eighth, being the next day. Last food between 5 and 6 P.M. yesterday. Up this morning at 6 A.M. Urine passed at 10 P.M., last night, was chylous.

2 A.M. Yellow milky; three ounces, acid. Slightly coagulating with heat and acid.

6^h A.M. Quite clear; healthy-looking. Two ounces; acid. Contained no trace of albumen. Specific gravity = 1026.4. 513.2 grs. precipitated by alcohol. Precipitate = 0.85 gr. = 1.65 gr. per 1000 grs. of urine.

7^h 30^m A.M. Opalescent; one and a half ounce; feebly acid; gave a large precipitate with nitric acid and heat; contained multitudes of healthy blood-globules; no casts. On long standing gave a small bloody coagulum, which fell to the bottom of the bottle. Specific gravity = 1018.8. 509.4 grs. precipitated by alcohol. Precipitate = 0.65 gr. = 1.9 grs. per 1000 grs. of urine.

9 A.M. Opalescent; by 12 o'clock became a solid jelly; two ounces, alkaline. Passed just before breakfast, which consisted of a pint of milk and sago, with bread and little butter.

11^h 30^m A.M. Coagulated spontaneously to a strong, unclear, slightly milky jelly. About three ounces, alkaline, passed in my room. Says that he thinks he can tell when the urine will be most thick and bloody by the pain, pressure and dragging, with heat in the loins.

Ninth, being the next day. Last food at 6 P.M. the day previous; staid in bed today until 9^h 30^m A.M.

Urine passed at

3 A.M. Cloudy, opalescent; five ounces.

6^h 30^m A.M. Clear healthy water; an ounce and a half, highly acid. No precipitate with heat and acid.

8^h 40^m A.M. Clear, one ounce; contained the smallest trace of albumen. Specific gravity = 1024.2. He did not sleep from 6^h 30^m, but he remained in bed. This water was passed just before breakfast, which consisted of a pint of boiled milk and sago, bread, with a little butter. 512.1 grs. precipitated by alcohol. Precipitate = 0.85 gr. = 1.61 gr. per 1000 grs. of urine.

9^h 30^m A.M. Still clear, an ounce and a half in quantity, made on first getting up. Gave the most minute trace of albumen. Specific gravity = 1022.2. Very slightly acid. 511.1 grs. precipitated by alcohol. Precipitate = 0.60 gr. = 1.1 gr. per 1000 grs. of urine.

10^h 30^m A.M. Very milky, alkaline.

Tenth day. After animal food had formed the greatest part of his diet for ten days; he remained this day in bed until after breakfast.

Urine passed at

8^h 20^m A.M. Clear; no trace of albumen; acid. Specific gravity = 1023·4 grs. passed before breakfast. 511·7 grs. precipitated by alcohol. Precipitate = 0·40 gr. = 0·78 gr. per 1000 grs. of urine.

Eleventh day. The following morning; up early.

Urine passed at

8^h 10^m A.M. Cloudy; contained some blood-globules, but no trace of fibrinous casts; acid. Specific gravity = 1022·6; passed before breakfast. Gave a considerable precipitate with heat and acid. 511·3 grs. precipitated by alcohol. Precipitate = 9·40 grs. = 18·38 grs. per 1000 grs. of urine.

The following table shows these results clearly:—

Seventh day. Remained in bed late.

		Specific gravity.	Precipitate by alcohol.
8 ^h 10 ^m A.M. In bed.	Urine passed before breakfast, clear	= 1021·3	= 0·6 gr. per 1000 grs. of urine.
9 ^h 30 ^m A.M. In bed.	Urine passed after breakfast, opalescent	= 1019·0	= 2·7

Eighth day. Up early.

6 A.M. On getting up.	Urine passed before breakfast, clear	= 1026·4	= 1·6
7 ^h 30 ^m A.M. Up.	Urine passed before breakfast, opalescent	= 1018·8	= 11·9

Ninth day. Remained in bed late.

8 ^h 40 ^m A.M. In bed.	Urine passed before breakfast, clear	= 1024·2	= 1·6
9 ^h 30 ^m A.M. On getting up.	Urine passed after breakfast, clear	= 1022·2	= 1·1

Tenth day. Remained in bed.

8 ^h 20 ^m A.M.	Urine passed before breakfast, clear	= 1023·4	= 0·78
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Eleventh day. Up early.

8 ^h 10 ^m A.M.	Urine passed before breakfast, cloudy	= 1022·6	= 18·38
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Healthy urine free from albumen, precipitated by } alcohol in excess.....	= 1020·2	= 2·15
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Second experiment.....	= 1021·2	= 3·48
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The precipitate chiefly consisted of sulphates and a little phosphate of lime, and no uric acid.

These experiments show most clearly the influence of rest and the effect of rising, (and even of waking) in causing the albumen to appear in the urine. The comparison of the 8th day with the 7th or 9th, and the great difference between the 11th and 10th days is quite conclusive. In other experiments I frequently determined before-hand whether the urine before breakfast should be albuminous or not, by directing the patient to get up and move about early or to keep very quiet in bed. And by keeping in bed all the day the urine throughout the whole day was very slightly albuminous.

It appeared to me to be very desirable to see whether the blood was milky. Mr. WILSON, of Tavistock Street, through whose kindness the patient came to me, bled him for me. The veins were filled with blood rather longer than usual before the opening was made; the blood came in a tolerable stream. The dinner, at 1^h 30^m P.M., consisted of a mutton chop with vegetables and bread. The blood was taken at 4^h 30^m P.M. into a thin wide mouth bottle. It was left to stand fourteen hours. There was no appearance of buff or cupping. The serum was opalescent, but not at all milky; and when agitated with ether it did not become clear, and the quantity of fat dissolved in the ether was very small.

Blood . . . = 1216·2 grs.

(1.) Serum poured off = 288·5 grs. Residue on evaporation = 26·9 grs.

Hence water . . = 261·6 grs.

(2.) Clot washed with distilled water until colourless.

Fibrin dried, *in vacuo* . . . = 3·20 grs.

= 2·63 grs. per 1000 grs. of blood.

(3.) Blood-globules, *plus* residue of serum, } = 924·3 grs.
minus fibrin. }

Evaporated to dryness = 261·8 grs.

Hence water = 662·5 grs.

contain by (1.) 68·1 grs. of solids of serum.

Therefore blood-globules = 261·8 - 68·1 = 193·7 grs. = 159·3 grs. per 1000 grs. of blood.

Total solids of serum = 68·1 + 26·9 = 95·0 grs. = 78·1 grs. per 1000 grs. of blood.

(4.) Dried blood-globules, and serum, in the proportion of one-quarter serum to three-quarters globules, were treated with ether frequently: 99·7 grs. gave 0·25 gr., soluble in ether = 2·6 grs. of fat per 1000 grs. of dry residue.

Hence in 1000 parts of blood—

Fibrin	2·63
Blood-globules	159·3
Solids of serum	78·1
Total solid residue	240·03
Water	759·97
Fat	0·62

The urine made the same day on which he was bled was also examined.

That passed at

6^h 30^m A.M. Clear.

8 A.M. Slightly cloudy. Then got up and had breakfast on arrow-root.

10 A.M. A solid and pinkish-white coagulum formed in the urine spontaneously.

1^h 30^m P.M. Milky, with some blood and spontaneous coagula. Six ounces passed just before dinner, which consisted of a mutton chop, with vegetables and bread.

4 P.M. Milky; five ounces.

4^h 30^m P.M. Milky; one ounce, mixed afterwards with 4 o'clock water. It contained a very little blood. He was bled immediately afterwards. Four ounces of this urine were evaporated to dryness, treated with boiling water, filtered, tested with sulphate of copper and liquor potassæ; gave no evidence of sugar.

6 P.M. Very milky urine, with blood-globules and coagula. Specific gravity = 1018; neutral to test-paper; about two ounces, made before tea.

509.0 grs. evaporated, *in vacuo*, over sulphuric acid—

Residue = 28.95 grs.

= 56.87 grs. per 1000 grs. of urine.

Ash = 5.50 = 10.80 grs. per 1000 grs. of urine.

509.0 grs., precipitated by an excess of alcohol—

Albumen and fat = 10.90 grs. . . . = 22.41 grs. per 1000 grs. of urine.

Ether dissolved = 3.8 grs. . . . = 7.46 grs. per 1000 grs. of urine.

Therefore albumen = 13.95 grs. per 1000 grs. of urine.

509.0 grs., evaporated to dryness, treated with absolute alcohol, filtered when cold—

Residue = 12.85 grs. = 25.24 grs. per 1000 grs. of urine.

Ash = 0.60 gr. = 1.18 gr. per 1000 grs. of urine.

Therefore urea and extractive = 24.06 grs. per 1000 grs. of urine.

Hence—

Total dry residue = 56.87 grs. per 1000 grs. of urine. Specific gravity = 1018.

Total ash = 10.80

Albumen = 13.95

Fat = 7.46

Urea, &c. . . . = 24.06

Loss = .60

Water = 943.13

1000.00 grs.

The conclusions from these experiments are:—

1st. That so-called chylous urine may contain fat, albumen, fibrin and healthy blood-globules.

2ndly. That although the fat passes off in the urine after food is taken, yet the albumen and fibrin and blood-globules are thrown out before any food has been taken. During perfect rest the albumen ceases to be excreted, and it does not appear in quantity in the urine even after food is taken, provided there is perfect rest. A short time after rising early the urine may coagulate spontaneously, although no fat is present in perceptible quantity, and this may happen previous to any food.

3rdly. Though the urine made just before and a short time after bleeding was as milky as it usually was at that period of the day, yet the serum of the blood was not milky. It did not contain a larger quantity of fat than healthy blood does. In other

respects, excepting in the diminution of the solids in the serum, the analysis of the blood corresponds with that of a case of cerebral congestion given by ANDRAL.

	Cerebral congestion.	So-called chylous urine.
Fibrin	2·7	2·63
Globules	152·3	159·3
Solids of serum	105·0	78·1
Water	740·0	759·97

The general results are—

1st. That the most important changes in the urine take place independently of the influence of digestion.

2ndly. That the urine in one respect only resembles chyle, and that is in containing, after digestion, a large quantity of fat in a very fine state of division; but the excess of fat in the urine is not caused by any excess of fat in the blood, for no excess of fat was found there.

3rdly. It appears that some change is produced in the kidney by which fibrin, albumen, globules and salts are allowed to pass out whenever the circulation through the kidney is increased: if, at the same time, fat is present in the blood, it escapes also into the urine.

That this change of structure is not visible to the naked eye on *post mortem* examination of the kidneys, Dr. PROUT long since demonstrated; and in a case of this disease, which was in St. George's Hospital, and was examined at Plymouth, no disease of the kidney was observed. From the total absence of fibrinous casts of the tubes from this urine, it is not improbable that by the microscope a difference may be detected in the structure of the mammary processes rather than in that of the cortical part of the kidney.