BLOOD UREA DETERMINATIONS IN 211 CASES *

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LITERATURE REVIEW

Increased urea in the blood was first demonstrated in 1823 by Prevost and Dumas,¹ while working with nephrectomized animals. Bostock,² in 1829, noticed an increase in the blood urea of certain albuminurics. Richard Bright³ with his co-workers—Prout, Babbington, and Christison (1836)—confirmed this observation and recognized it to be of clinical importance in nephritis. Babbington and Christison also made estimations of urea in body fluids.

Following the qualitative demonstration of blood urea, quantitative determinations were attempted by both French and German clinicians. Picard⁴ (1856) was the first to determine that the amount of blood urea varies with the nitrogen intake.

Interest in the subject abated about this time, and for a period of forty years the references in the literature were infrequent. Schöndorff⁵ (1899) revived the subject by an examination of the previous work, adding to it his own more accurate results, which confirmed the work of his predecessors. He observed that the urea fraction of the total nonprotein nitrogen of the blood was variable. Ascoli,⁶ in 1901, using a precipitation method (acetic acid and sodium chlorid), and Strauss⁷ (1902) with a similar method (heat and acetic acid), found that in cases of severe nephritis there was usually nitrogen accumulation. He found a marked increase in the terminal state. Müller⁸ (1905) recognized urea retention to be of the highest value in diagnosing cases of uremia.

F. Vidal and Javal⁹ (1905) found that urea was retained in some cases of Bright's disease, and advocated a diminished protein diet in those cases.

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1. Prevost and Dumas: *Ann. de chimie et de physique*, 1823, xxiii, 90.

2. Bostock: *Edinburg Med. and Surg. Jour.*, 1829, xxxii, 28.

3. Bright, Babbington, and Christison: *Guy's Hosp. Rep.*, 1836, i, 360.

4. Picard: *Thèse de Strassburg*, 1856.

5. Schöndorff: *Arch. f. d. ges. Physiol. (Pflüger's)*, 1899, lxxiv, 358.

6. Ascoli: *Pflüger's Arch. f. path. Anat.*, 1901, lxxvii, 103.

7. Strauss: *Die Chronische Niereutzündungen in ihrer Einwirkung auf die Blutflüssigkeit und deren Behandlung*, Hirschwald, Berlin, 1902.

8. Müller: *Verhandl. der deutsch. path. Gesellsch.*, 1904-5, vii-ix, Supplement 80.

9. Vidal and Javal: *Semaine méd.*, 1905, xxv, 313.

Von Noorden¹⁰ (1907) obtained inconstant findings, but believed that the nitrogen accumulation in the blood constituted one of the most important phenomena of renal insufficiency.

Obermayer and Popper¹¹ (1909) confirmed the results of previous workers, finding the incoagulable nitrogen higher in uremic cases than in normal cases, and emphasized especially the increase in the urea fraction. They used heat and acetic acid for coagulation of blood proteins.

Hohlweg¹² (1911) used acetic acid and monopotassium phosphate, half saturated with sodium chlorid, to precipitate the blood proteins. He found increased values in uremia, but found them also in other conditions. While he considered nitrogen accumulation in the blood nonspecific of uremia, he thought it was of some prognostic value.

Widal¹³ (1911) using the hypobromite method, based a prognosis on the amount of urea per liter; patients with 1 to 2 gm. per liter rarely live more than a year; with 2 to 3 gm. only months or weeks; and with more than 3 gm. a very short time. This prognosis, however, he did not apply to cases with renal obstruction, where such obstruction could be removed, as here he found the urea dropped when the obstruction was relieved. He found the retention was more permanent in chronic Bright's disease. He believed the amount of blood urea was of definite value in the prognosis, especially of those cases difficult to determine from the clinical symptoms alone.

Foster¹⁴ (1912) using an alcohol precipitation and fractional separation method, found a considerable increase in nonprotein nitrogen in severe nephritis and in some other conditions. When the total nitrogen reached 1 gm. per liter, he regarded the prognosis as grave.

Rowntree and Fitz¹⁵ (1913) used the original Widal method in part of their determinations, but in the main they precipitated by the Widal method and then determined the nitrogen by the Kjeldahl method. They reported the results obtained in fifty-seven cases. No increase of blood urea was found in suspected nephritis (i. e., clinically). In mild nephritis the average was 0.38 gm. urea per liter; in cases of advanced nephritis 0.783 gm. per liter; cases of cardiac decompensation without nephritis 0.70 gm. per liter; and cardiac decompensation associated with nephritis 0.831 gm. per liter. In summarizing, they believed that the accumulation of nonprotein nitrogen in the blood of nephritics was of considerable prognostic value. When

10. Von Noorden: *Metabolism and Practical Medicine*, 1907, ii, 486.

11. Obermayer and Popper: *Ztschr. f. klin. Med.*, 1911, lxxii, 332.

12. Hohlweg: *Deutsch. Arch. f. klin. Med.*, 1912, civ, 216.

13. Widal: *Bull. et. mém. Soc. méd. d. hôp. de Paris*, 1911, xxxii, 627.

14. Foster: *THE ARCHIVES INT. MED.*, 1912, x, 414.

15. Rowntree and Fitz: *THE ARCHIVES INT. MED.*, 1913, xi, 258.

it occurred it was confirmatory evidence of renal insufficiency, whereas the absence of such increase was of less importance. As a point in differentiating cardiac and renal diseases they believed it was also of importance.

Frothingham, Fitz, Folin and Denis¹⁶ (1913) found that the blood urea and the phenolsulphonephthalein excretion varied from normal in animals subjected to experimental uranium nephritis, and the amount of such variation agreed with the amount of kidney destruction. They observed a gradual increase in urea as nephritis developed and a gradual decrease as the kidney recovered. They concluded that the urea in the blood is a measure of the difference between the waste nitrogen urea produced in metabolism and the amount excreted in the urine. Such a retention of nitrogen in experimental nephritis was found also by Siegel,¹⁷ Pearce, Hill and Eisenbrey,¹⁸ Austin and Eisenbrey,¹⁹ Folin, Karsner, Howard and Denis²⁰ and Mosenthal²¹ (uranium, cantharidin, chromate, etc., nephritis). Mosenthal stated that there "Seems no doubt that kidney insufficiency in these cases is responsible for the retention." Karsner²² also found retention in experimental arsenical nephritis, especially during the stage in which tubular destruction was most marked.

Soper and Granat²³ (1914) studied a series of ninety-seven cases, observing the urea content in spinal fluids. Their work will be referred to later under discussion of body fluids.

Folin, Denis and Seymour²⁴ (1914) reported a series of clinical experiments showing the relation of the nonprotein nitrogen and of the urea of the blood of nephritics to the amount of protein intake. Under low protein diet they were able to reduce the urea content from 0.67 gm. per liter to practically a normal amount. They conclude that the rational means of determining protein tolerance is by determining the nonprotein nitrogen retention and not by blood pressure findings. They found no connection between nitrogen retention and blood pressure as had previously been described by Strauss, who believed that the high blood pressure of nephritics is frequently associated with nitrogen retention.

16. Frothingham, Fitz, Folin, and Denis: *THE ARCHIVES INT. MED.*, 1913, xii, 245.

17. Siegel: *Ztschr. f. exper. Path. u. Therap.*, 1907, iv, 561.

18. Pearce, Hill, and Eisenbrey: *Jour. Exper. Med.*, 1910, xii, 196.

19. Austin and Eisenbrey: *Jour. Exper. Med.*, 1911, xiv, 366.

20. Folin, Karsner, Howard, and Denis: *Jour. Exper. Med.*, 1912, xvi, 789.

21. Mosenthal: *THE ARCHIVES INT. MED.*, 1914, xiv, 844.

22. Karsner and Denis: *Jour. Exper. Med.*, 1914, xix, 63.

23. Soper and Granat: *THE ARCHIVES INT. MED.*, 1914, xiii, 131.

24. Folin, Denis, and Seymour: *THE ARCHIVES INT. MED.*, 1914, xiii, 224.

Agnew²⁵ (1914), using the method of Folin and Denis,²⁶ found in the majority of cases of nephritis, when the excretion of phenolsulphonophthalein was below 40 per cent., there was an increase in the nonprotein blood nitrogen and in the blood urea. This did not hold true in cases of cardiac decompensation. He found the incoagulable nitrogen determinations valuable in the diagnosis of incipient uremia, coma, and in conjunction with phenolsulphonophthalein in cardiorenal diseases.

Frothingham and Smillie²⁷ (1914), using the method of Folin and Denis, found many cases of chronic nephritis with normal nonprotein nitrogen in the blood. Cases showing 0.35 gm. per liter were clinically more severe than the cases with no retention, while the cases with 0.5 gm. or over were clinically of still more severe type. No nonnephritic cases showed nitrogen retention. They found that the excretion of phenolsulphonophthalein varied inversely with the retention of nitrogen, except in cases of cardiac decompensation. Blood pressure and pulse pressure they believed to be of less prognostic value than nitrogen retention.

Tileston and Comfort²⁸ (1914), following the technic of Folin and Denis, observed a large series of cases (142). Their most important deduction was that in chronic nephritis without uremia the urea values were normal or moderately elevated. Cases of uremia showed great increase without exception. The excretion of phenolsulphonophthalein was proportional to the nitrogen retention. Outside of uremia, extremely large urea values, over 1 gm. per liter, were encountered only in severe anemias and intestinal obstruction. They found retention in chronic plumbism, lobar pneumonia, syphilis (36 per cent. of cases), diabetes with coma, and acute yellow atrophy of the liver. Normal values were obtained in eclampsia, chronic passive congestion, compensated valvular lesions, pericarditis, endocarditis, acute rheumatism, uncomplicated scarlatina, cerebral hemorrhage, functional nerve diseases, diabetes without coma, myxedema, exophthalmic goiter, and malignant disease. They believed the estimation of nitrogen to be of the greatest value in the diagnosis of uremia and also in the prognosis of chronic nephritis. They thought that the total nitrogen was of more prognostic importance than the urea nitrogen.

Ovsiannikova²⁹ (1914) found a mortality of 18 per cent. in cases of chronic nephritis with blood urea below 0.5 gm. per liter; 18 per

25. Agnew: *THE ARCHIVES INT. MED.*, 1914, xiii, 485.

26. Folin and Denis: *Jour. Biol. Chem.*, 1913, xiv, 29.

27. Frothingham and Smillie: *THE ARCHIVES INT. MED.*, 1914, xiv, 541.

28. Tileston and Comfort: *THE ARCHIVES INT. MED.*, 1914, xiv, 620.

29. Ovsiannikova: *Russk. Vrach.*, 1914, xiii, 253.

cent. for 0.5 to 1 gm. per liter; 58 per cent. for 1 to 2 gm. per liter; and 85 per cent. for 2 to 5 gm. per liter.

Widal, Weill and Radot³⁰ (1914) found that the phenolsulphone-phthalein test and the urea in the blood serum ran parallel. They rose and fell together in normal cases and in cases of Bright's disease. The mere estimation of the urea content of the blood from time to time they believed to be a reliable and accurate index of the azotemia. In chronic kidney disease when the urea was less than 0.5 gm. per liter there was no question of azotemia; when 1 gm., they believed the test should be frequently repeated; when 2 gm., the prognosis was bad.

TABLE 1.—NORMAL

Number	Age	Blood Pressure	Phthalein, Per Cent.	Blood Urea	
				Two Hours After Meals	Seventeen Hours Fasting
38	23	100	72	0.168	.....
39	21	102	87	0.168	0.120
40	21	122	67	0.156	0.156
41	21	122	82	0.120	.....
43	20	...	..	0.180	.....
47	24	116	..	0.192	.....
58	22	100	67	0.192	.....
11	36	112	79	0.180	0.132
69	21	110	..	.....	0.108
77	23	...	65	0.160	.....
82	21	...	42	0.220	.....
83	23	126	60	0.216	.....
176	25	122	82	0.252	.....
195	20	120	50	0.204	.....
196	26	132	65	0.108	.....
197	22	120	70	0.120	.....

Farr and Krumbhaar³¹ (1914) stated that in cirrhosis of the liver the total nitrogen was increased only in cases accompanied by definite nephritis. They did not support the view held by Morel and Mouriquand,³² and by some other investigators, that in destructive diseases of the liver the percentage of urea to the total nitrogen was decreased; to the contrary, they found that the percentage of urea remained normal.

30. Widal, Weill, and Radot: *Presse. méd.*, 1914, xxii, 565.

31. Farr and Krumbhaar: *Jour. Am. Med. Assn.*, 1914, lxiii, 2214.

32. Morel and Mouriquand: *Bull. et. mém. Soc. méd. d. hôp. de Paris*, 1913, xxxv, 266.

Mosenthal²¹ (1915), in a series of interesting experiments, was able to produce in dogs experimental uranium nephritis of two types. In nephritis of moderate severity there was an increase in nitrogen elimination. This increase he demonstrated experimentally to be due, not to any previous retention, but to an increased protein catabolism. The more severe cases showed a decreased elimination of nitrogen in the urine with a true nitrogen retention due to kidney insufficiency. He also showed that a gain or loss of water in the body was a factor that influenced the quantitative estimations of nonprotein nitrogen in the blood.

Foster³³ (1915) observed a series of cases of severe cardiac decompensation without nephritis, and found in them an increase in the nonprotein nitrogen averaging 0.6 gm. per liter. In four of these cases necropsy substantiated the clinical findings. The nonprotein nitrogen in chronic parenchymatous he found lower than in chronic interstitial nephritis. In general, he found the most pronounced nitrogen increase in cases with high arterial pressure. He states that uremia may occur when the nitrogen is low, that is, no higher than in a latent nephritis. The convulsive type of uremia showed a nitrogen content double that of the asthenic type. A high nonprotein nitrogen in the absence of uremic symptoms he believed to be of more definite prognostic value than in the presence of uremic symptoms, while a normal finding did not exclude a remotely fatal issue.

Rowntree, Marshall, and Baetjer³⁴ (1915) also reported two cases of myocardial insufficiency with necropsies showing no kidney changes except chronic passive congestion. Clinically, both showed urea retention, 0.67 and 1.1 gm. per liter, respectively.

TECHNIC

We have used in this series of experiments the urease method of Marshall,³⁵ fully described by the author.

BLOOD UREA IN NORMAL CASES

The several observers have obtained widely varying values for the normal blood urea, largely due to the method employed. A glance at Table 2 will show this clearly.

Our observations cover a series of sixteen cases, all persons in apparently perfect physical condition. The urine in each case was normal. The average amount of blood urea obtained after seventeen hours fasting was 0.129 gm. per liter. Two and one-half hours after

33. Foster: *THE ARCHIVES INT. MED.*, 1915, xv, 356.

34. Rowntree, Marshall, and Baetjer: *THE ARCHIVES INT. MED.*, 1915, xv, 543.

35. Marshall: *Jour. Biol. Chem.*, 1913, xiv, 283; *ibid.*, 1913, xv, 487.

TABLE 2.—NORMALS OF VARIOUS AUTHORS

Gm. per Liter	Authors	Method
0.20 to 0.41.....	Foster	Alcoholic precipitation and fractional separation.
0.30 to 0.50.....	Rowntree and Fitz.....	Widal hypobromite and Kjeldahl.
0.61.....	Schöndorff (quoted by Agnew).....	Phosphotungstic acid precipitation.
0.10 to 0.20.....	Strauss (quoted by Agnew).....	Heat and acetic acid.
0.23 to 0.28.....	von Jaksch ³⁷	Phosphotungstic acid precipitation.
0.18.....	Obermayer and Popper.....	Heat and acetic acid.
0.31.....	Hohlweg	Dilute acid, 5 per cent. monopotassium phosphate and one-half saturated sodium chloride.
0.11 to 0.14.....	Folin and Denis.....	Precipitation with methyl alcohol, then with zinc chloride, hydrolyzed, Ness-
0.21.....	Aszacki ³⁸	lized, and colorimetry.
0.08 to 0.25.....	Farr and Austin ³⁹	Uranium acetate.
0.43.....	Farr and Austin (quoted by Hinman).	
0.30 to 0.50.....	Widal	Hypobromite method.
0.12 to 0.14 (2½ hours).....	Tilleston and Comfort.....	Technic of Folin and Denis.
0.13 to 0.20 (12 hours).....	Tilleston and Comfort.....	Technic of Folin and Denis.
0.05 to 0.07 (fasting)	Pleard	Precipitation with alcohol and then Liebig's titration method.
0.11 to 0.13 (after food).....	Pleard	
0.50.....	Well, Vallery and Radot ⁴⁰ (quoted by Hinman)	

37. Von Jaksch: Leyden Festschr., 1902, i, 197.

38. Aszacki: Ztschr. f. klin. Med., 1913, lxxvii, 1.

39. Farr and Austin: Jour. Exper. Med., 1913, xviii, 228.

40. Widal, Weill, Vallery, and Radot: Jour. d'Urol., 1913, v, 68.

a heavy protein meal this was increased to 0.175 gm. per liter, or an average increase of 0.046 gm. per liter. Reference to Table 1 will show that the values obtained varied from 0.108 gm. per liter to 0.252 gm. per liter, in no case reaching 0.300 gm. per liter. The average per cent. of phenolsulphonephthalein excreted in two hours was 68.

RELATION OF PROTEIN INTAKE

That the amount of protein ingested had a distinct bearing on the quantity of blood urea, was observed by Picard in 1856. He found also that the time for taking blood for examination, with reference to food intake, caused certain variations. These observations have been repeatedly confirmed and emphasized by different authors.

Case 80, of our own observation, demonstrates this very clearly. A normal individual, with a phenolsulphonephthalein excretion of 60 per cent., had a blood urea of 0.326 gm. per liter. She gives a history of being a heavy meat eater. On a low protein diet for a period of three days the blood urea dropped to 0.168 gm. per liter; later, on a moderate protein diet the value increased to 0.240 gm. per liter. In nephritics, who have been given a low protein diet, we have also observed a drop in the blood urea (Case 56). The practical value of giving a low protein diet to decrease the nonprotein nitrogen in the blood of nephritics, has been recently demonstrated by various authors (Folin, Denis and Seymour, Tileston and Comfort, etc.).

CAUSES OF BLOOD UREA INCREASE

The finding of a normal as well as an increased amount of urea in nephritics, along with the fact that there is increased urea in numerous pathological conditions, in which no clinical or pathological evidence of nephritis exists, leads us to the conclusion that blood urea increase cannot be explained by renal insufficiency alone. Faulty kidney excretion, resulting in true nitrogen retention, is no doubt the chief factor in cases of nephritis, but many other cases cannot be explained on the basis of retention. We observe in some cases involving general metabolism, without any evidence of nephritis, an increased blood urea. Cases of exophthalmic goiter show a moderate increase. In one case we observed still greater increase during a condition of hyperthyroidism following a partial gland resection. This increase dropped to normal simultaneously with the improvement of the patient.

Whether increased protein catabolism alone explains these cases is difficult to state. There may be an abnormal urea combination in the blood, which makes elimination by the kidney impossible, as has been suggested by Mosenthal.

TABLE 3.—ACUTE NEPHRITIS

No.	Age	Diagnosis	Kidney	Urine				Blood Pressure	Phthal- em, per Cent.	Blood Urea	Remarks
				Quan., c.c.	Sp. Gr.	Alb.	Microscopic				
2	29	Puerperal septice- mia	Acute toxic nephritis	Spec.	1.012	S. A.	Pos.	Many gran. casts	..	0.924	Death next day.
6	48	Lobar pneumonia	Acute toxic nephritis	Spec.	1.022	M. A.	Pos.	Blood casts	137	0.120	Recovery.
12	55	Acute bowel ob- struction	Acute toxic nephritis	Spec.	.....	L. A.	Pos.	Many hy. gran. and blood casts	...	1.380	Died two days later.
34	54	Lobar pneumonia	Acute toxic nephritis	900	1.016	M. A.	Neg.	Gran. and hy. casts	118	0.480	Died one day later. Fourth day of disease.
36	44	Lobar pneumonia	Acute toxic nephritis	Spec.	1.016	S. A.	Pos.	Occ. gran. cast...	104	0.660	Fourth day of dis- ease.
42	24	Lobar pneumonia	Acute toxic nephritis	Spec.	1.080	S. A.	Neg.	Hy. and gran. casts	...	0.264	Third day.
52	21	Lobar pneumonia	Acute toxic nephritis	Spec.	1.022	T.	Neg.	Occ. gran. cast;	...	0.288	Fifth day.
54	34	Lobar pneumonia	Acute toxic nephritis	Spec.	1.022	M. A.	Neg.	Occ. W.B.C.	...	0.396	Fifth day. Died
60	22	Pregnancy (5 mo.) Appendicitis.....	Acute toxic nephritis	600	1.012	M. A.	Neg.	Many hy. casts...	108	0.540	Next day.
			Acute toxic nephritis	1,800	1.007	S. A.	Neg.	Few W.B.C.; Many W. B. C.;	126	0.180	Second day. Recov.
71	55	Lobar pneumonia	Acute toxic nephritis	Spec.	1.018	T.	Neg.	Occ. hy. cast	...	0.264	3/10. Recovery.
73	39	Lobar pneumonia	Acute toxic nephritis	Spec.	1.022	T.	Neg.	Few gran. casts..	99	0.624	Died same day.
87	43	Lobar pneumonia	Acute toxic nephritis	Spec.	1.022	T.	Neg.	Few gran. and hy. casts; few W.B.C.	110	0.420	Second day after onset.
95	27	Acute parenchy- matous	Acute toxic nephritis	Spec.	1.022	M. A.	....	Many gran. and hy. casts; Occ. W.B.C.	94	0.384	Fourth day after onset.
106	28	Lobar pneumonia	Acute toxic nephritis	.....	1.007	M. A.	Pos.	.....	90	0.300	Sixth day.
115	8	Primary anemia...	Acute toxic nephritis	Spec.	.....	.....	Pos.	Few hy. casts; R.B.C.	92	0.597	Died two days later.
121	32	Acute pulmonary tuberculosis	Acute toxic nephritis	Spec.	1.022	L. A.	....	Hy. casts; few W.B.C.	110	0.600	Died next day.
122	43	Lobar pneumonia..	Acute toxic nephritis	Spec.	1.020	S. A.	Neg.	Occ. hy. and gran. casts; Occ. W.B.C.	112	0.456	Ninth day.
144	39	Common duct ob- struction	Acute toxic nephritis	Spec.	1.018	T.	....	Many hy. and gran. casts	125	1.512	5/10. Bile in urine.
				900	1.014	T.	Pos.	Occ. hy. cast....	...	1.560	5/11.
				250	1.023	T.	....	Occ. hy. cast....	...	0.936	5/14.
151	37	Lobar pneumonia	Acute toxic nephritis	Spec.	1.023	M. A.	Neg.	Occ. W.B.C.	...	0.168	5/29. Sugar trace.
156	32	Acute parenchy- matous	Acute toxic nephritis	Spec.	1.015	M. A.	Pos.	Nun. hy. casts...	140	0.144	6/ 2.
				Spec.	1.015	M. A.	Pos.	Few hy. casts; W.B.C. and R.B.C.	134	0.660	Fourth day. Died same day.
				1,000	1.008	M. A.	Pos.	Gran. and hy. casts	...	0.720	5/15.
				Spec.	1.008	T.	Pos.	Hy. and gran. casts; W.B.C.	130	0.912	5/19.
				Spec.	1.018	T.	Pos.	Hy. and cellular casts; R.B.C. and W.B.C.	...	0.576	5/22.
				Spec.	1.017	S. A.	Neg.	Occ. hy. cast;	...	0.672	5/25.
163	30	Lobar pneumonia	Acute toxic nephritis	Spec.	1.017	S. A.	Neg.	Nun. W.B.C.	112	0.336	5/31. Left hospital in fair condition.
175	25	Lobar pneumonia	Acute toxic nephritis	Spec.	1.025	T.	Pos.	W.B.C. and R.B.C.	...	0.444	Third day. Died same day.
178	39	Lobar pneumonia	Acute toxic nephritis	Spec.	1.018	T.	Neg.	Hy. and gran. casts; W.B.C.	100	0.336	Second day.
181	42	Lobar pneumonia	Acute toxic nephritis	Spec.	.....	T.	Neg.	Occ. hy. cast; Occ. W.B.C.	...	0.582	Fourth day. Died next day.
187	50	Meningitis.....	Acute toxic nephritis	Spec.	1.016	M. A.	Pos.	Occ. W. B. C.; many gran. casts	140	0.636	Fourth day.
				Spec.	1.016	M. A.	Pos.	.....	...	0.384	Fourth day. Died six hours later.

Cases of acute infection often present the same picture. Here there is undoubtedly increased catabolism along with the elevation of temperature. It seems quite probable that an abnormal urea compound, as well as an absolute increase in the amount of urea nitrogen formed, combined with kidney insufficiency of varying degree, occurs in the terminal state.

That pure circulatory disturbance may give rise to increase in blood urea has been demonstrated in cases of cardiac decompensation, where necropsy showed the absence of kidney lesions (Foster).

Another factor which has to be considered is the percentage of water in the body fluids. In cases of persistent vomiting, esophageal stenosis, acute hemorrhage, etc., we have observed an increase in the blood urea, and conversely, in a case of high blood urea, we have observed a distinct drop following the addition of a considerable quantity of water to the body fluids. Concentration of and dilution of the blood probably account in part at least for these phenomena.

UREA IN PATHOLOGICAL CONDITIONS

In studying various pathological conditions we have considered a blood urea above 0.250 gm. per liter as abnormal. For purposes of classification we have divided the cases into clinical groups, including (1) acute nephritis, (2) suspected chronic nephritis, (3) mild chronic nephritis, (4) advanced chronic nephritis, (5) advanced chronic nephritis with cardiac decompensation, (6) miscellaneous genitourinary, (7) diseases of heart, (8) anemias, (9) acute infections, (10) chronic infections, (11) diabetes mellitus, (12) diseases of thyroid, (13) malignancy, (14) miscellaneous cases.

ACUTE NEPHRITIS

Twenty-five cases of acute nephritis were observed. Of these eighteen were toxic nephritis accompanying lobar pneumonia. The urea averaged 0.578 gm. per liter, thus showing a definite increase. Only three cases showed a normal amount of urea. All showed albumin and casts in the urine. Twenty-two phthalein tests were made; sixteen showed decreased elimination.

Case 12 of intestinal obstruction following operation showed normal urea before operation. With developing obstruction, many hyaline and granular casts, with a large amount of albumin, appeared in the urine. The blood urea was 1.390 gm. two days before death.

Cases 95 and 156 were acute parenchymatous nephritis of no determined etiology. Case 156 entered the hospital the third day of illness, complaining of weakness and headache. His previous history was entirely negative. He showed a medium amount of albumin, casts,

TABLE 4.—SUSPECTED CHRONIC NEPHRITIS

No.	Age	Diagnosis	Kidney	Urine				Blood Pressure	Phthal- ein, per Cent.	Blood Urea	Remarks
				Quan., c.c.	Sp. Gr.	Alb.	Blood				
3	50	Arteriosclerosis....	Arteriosclerotic	Spec. Spec.	1.020 1.026	T. T.		250 ...		0.096 0.118	Hyperthyroidism.
7	72	Cystitis.....	Chronic interstitial nephritis	Spec.	1.005	T.	Pos.	150	..	0.084	
8	54	Headache.....	Chronic interstitial nephritis	Spec.	1.008	T.	....	135	..	0.210	
46	55	Prostatic hyper- trophy	Chronic interstitial nephritis	Spec.	1.004	S. T.	....	190	..	0.288	
50	67	Suspected chronic nephritis		1,500	1.012	S. T.		122	77	0.288	4/21. B. P. 145 af- ter 1 day in bed. 5/18.
101	55	Suspected chronic nephritis	.....	1,800	1.015	S. T.	....	120	65	0.264	
102	35	Edema.....	.....	Spec.	.....	S. T.	....	130	..	0.336	
105	47	Suspected nephro- lithiasis	.....	Spec.	.....	S. A.	Pos.	180	70	0.242	
114	60	Arteriosclerosis....	.....	400	1.015	S. T.	....	160	65	0.546	
127	65	Prostatic hyper- trophy	.....	Spec.	1.023	S. T.	....	134	72	0.240	
182	46	Suspected chronic nephritis		700	1.009	T.		140	66	0.182	Dyspnea. Edema.
174	67	Suspected chronic nephritis Hemorrhage, re- tina	.....	Spec.	1.016	S. T.	Pos.	186	..	0.264	

white and red blood cells, a phthalein of 26 per cent., and urea of 0.720 gm. per liter. A few days later the urea rose to 0.912 gm. per liter. With improvement in symptoms the urea fell promptly and phthalein elimination increased to normal.

Case 144 was common duct obstruction. When the patient entered the hospital she showed blood urea of 1.512 gm. per liter, with 13 per cent. phthalein excretion. The common duct opened spontaneously and at the same time the accompanying nephritis began to clear. The urea and phthalein promptly returned to normal.

These cases followed practically the same course observed by the various investigators of acute experimental nephritis.

SUSPECTED CHRONIC NEPHRITIS

Twelve cases which were clinically suspected of being nephritis, showed an average urea of 0.248 gm. per liter, which is a normal value. The phthalein excretion was normal on all the cases which were examined. Reference to Table 4 will show the details of each case.

MILD CHRONIC NEPHRITIS

Table 5 shows the results in the nineteen cases of mild chronic nephritis. Of these five were parenchymatous and fourteen were interstitial nephritis. The average blood urea was 0.288 gm. per liter. Five of the cases showed normal blood urea. The phthalein excretion in this group was, with one exception, normal.

ADVANCED CHRONIC NEPHRITIS

Sixteen cases of advanced chronic nephritis came under our observation. The average blood urea of these cases was 0.444 gm. per liter. Three cases showed normal values.

Two cases of albuminuric retinitis associated with chronic parenchymatous nephritis were observed. It is interesting to note that both of these cases showed a normal urea. Widal has stated that albuminuric retinitis is always associated with azotemia. Tileston and Comfort had one case which also showed a normal urea value, but in the cases of long standing eye symptoms the urea was increased. Both of the cases coming under our observation were of brief duration, as far as the retinitis was concerned. It is of interest to note that in one case with a urea of 0.180 gm. per liter the excretion of phthalein was but 15 per cent.

One case of uremia was observed. This was of transitory character, following a prostatectomy. The maximum urea at the time the patient had uremic symptoms was 1.008 gm. per liter, with but a trace of phthalein excreted. This case is also of interest, because

TABLE 5.—MILD CHRONIC NEPHRITIS

No.	Age	Diagnosis	Kidney	Urine				Blood Pressure	Phthal- em, per Cent.	Blood Urea	Remarks
				Quant., c.c.	Sp. Gr.	Alb.	Blood				
49	53		Chronic parenchyma- tous nephritis	1,400	1.016	T.		178	..	0.242	2 per cent. sugar. No sugar on 60 gm. white bread per day.
20	57	Diabetes mellitus..	Chronic interstitial nephritis	Spec. Spec.	1.030 1.012	T. T.	.... ....	154 ...	.. ..	0.150	
10	54	Cystitis.....	Chronic interstitial nephritis	Spec.	1.008	T.	....	154	70	0.276	
44	56	Prostatic hyper- trophy	Chronic interstitial nephritis	1,300	1.008	T.		180	75	0.168	Cystitis.
64	24	Post nephrectomy	Chronic interstitial nephritis	Spec.	1.005	S. T.	....	128	50	0.264	
75	80	Prostatic hyper- trophy	Chronic interstitial nephritis	Spec.	1.012	M. A.	Pos.	137	T	0.393	
123	45	Chronic pulmon- ary tuberculosis	Chronic parenchyma- tous nephritis	Spec.	1.025	T.		100	87	0.288	Iritis.
135	40	Syphilis.....	.....	Spec.	1.020	T.	Pos.	118	..	0.312	
138	35	Syphilis.....	Chronic interstitial nephritis	Spec.	1.011	S. T.	....	112	..	0.242	
136	33	Syphilis.....	Chronic parenchyma- tous nephritis	Spec.	1.017	T.		162	77	0.480	Menopause.
171	54	Syphilis.....	Chronic interstitial nephritis	Spec.	1.015	T.	....	170	..	0.420	
149	50	Tabes dorsalis.....	Chronic interstitial nephritis	Spec.	1.010	T.	....	140	..	0.312	
153	54	Arteriosclerosis....	Chronic interstitial nephritis	Spec.	1.006	S. T.	....	190	..	0.264	
180	34	Secondary anemia	Chronic interstitial nephritis	2,500	1.004	S. A.	....	140	62	0.264	
182	60	Chronic pulmon- ary tuberculosis		Spec.	1.022	T.		96	80	0.372	5 per cent. sugar.
183	42	Chronic interstitial nephritis	.....	Spec.	1.008	S. T.	....	138	67	0.204	
192	25	Chronic pulmon- ary tuberculosis	.....	200	1.016	T.	....	...	..	0.120	
202	54	Diabetes mellitus..	Chronic interstitial nephritis	2,820	1.030	T.	....	242	65	0.300	
186	40	Chronic antrum infection	Chronic parenchyma- tous nephritis	Spec.	1.020	S. A.	....	...	..	0.312	

TABLE 6.—ADVANCED CHRONIC NEPHRITIS

No.	Age	Diagnosis	Kidney	Urine				Blood Pressure	Phthal- ein, per Cent.	Blood Urea	Remarks
				Quan., c.c.	Sp. Gr.	Alb.	Blood				
4	78	Prostatic hyper- trophy	Chronic interstitial nephritis	1,400	1.015	S. T.	....	...	..	1.008	2/8.
5	26	Abortion. Albu- minuric retinitis	Chronic parenchyma- tous nephritis	Spec.	1.016	L. A.	Pos.	220	..	0.156	1/24. Before abor- tion.
				Spec.	1.010	L. A.	Pos.	190	..	0.180	1/26. Post abortion.
				Spec.	1.010	L. A.	Pos.	190	15	0.190	1/28.
				Spec.	1.016	M. A.	Neg.	250	..	0.144	1/31.
15	27	Albuminuric retin- itis	Chronic parenchyma- tous nephritis	Spec.	.....	L. A.	Pos.	220	..	0.228	2/22. Retinitis still marked.
16	33	Chronic parenchy- matous nephritis	.....	Spec.	1.005	S. A.	Pos.	154	..	.....	12/30.
				Spec.	1.008	T.	Pos.	154	..	0.324	1/7. Patient in fair condition.
18	55	Chronic interstitial nephritis	.....	Spec.	1.002	T.	Neg.	230	..	0.276	1/8.
22	16	Chronic parenchy- matous nephritis	.....	Spec.	1.015	L. A.	Pos.	...	..	.....	3/2.
				Spec.	1.003	M. A.	Pos.	150	30	0.372	4 months' duration.
28	33	Chronic interstitial nephritis	.....	2,800	1.006	T.	Neg.	134	55	0.408	History of scarlet fever and syphilis. Mercurial treat- ment.
				5,500	1.010	S. T.	....	...	..	.....	Limited fluids to 1,500 c.c. and gave 20 gm. NaCl in 24 hours.
48	51	Diabetes mellitus..	Chronic interstitial nephritis	480	1.025	T.	....	168	55	0.144	2/28. Diabetes four years' duration. 2.5 per cent. sugar.
51	51	Chronic parenchy- matous nephritis	.....	750	1.015	T.	....	...	..	.....	3/1. 0.5 per cent. sugar.
56	63	Chronic interstitial nephritis	.....	1,200	1.012	M. A.	Pos.	...	47	0.480	3/5. Suspected neph- ritis.
76	29	Chronic parenchy- matous nephritis	.....	Spec.	1.016	M. A.	Neg.	240	..	0.210	3/14.
118	52	Chronic interstitial nephritis	.....	Spec.	1.015	M. A.	Neg.	180	34	0.384	3/13. Six days' rest in bed.
				Spec.	1.014	L. A.	....	250	50	0.396	Has mild edema, cardiac hypertro- phy and pyorrhea.
134	47	Chronic interstitial nephritis	.....	Spec.	1.013	T.	Neg.	170	..	0.276	Cardiac hypertro- phy, mild edema, anemia, hematuria three years ago.
172	53	Diabetes mellitus..	Chronic interstitial nephritis	2,200	1.033	M. A.	....	...	..	1.080	Edema, ascites, dysp- nea. One year's duration. Obesity.
184	42	Diabetes mellitus..	Chronic interstitial nephritis	Spec.	1.015	M. A.	....	...	..	0.362	Gangrene. 1.3 per cent. sugar. Dia- cetic and acetone.
				Spec.	1.033	M. A.	....	150	75	0.336	Sugar-free on car- bohydrate-free diet 6/1. 5 per cent. su- gar. Acetone and diacetic.
191	58	.....	Arteriosclerotic .....	.....	1.025	T.	....	204	..	2.340	6/6. Coma. Died next day.
										0.396	1/12.

TABLE 7.—ADVANCED CHRONIC NEPHRITIS WITH CARDIAC DECOMPENSATION

No.	Age	Diagnosis	Kidney	Urine			Blood Pressure	Phthal- ein, per Cent.	Blood Urea	Remarks
				Quan., c.c.	Sp. Gr.	Alb.				
1	75	Bronchitis. Myo- carditis	Arteriosclerotic	400 800	1.022 1.018	M. A. T.	Pos.	...	0.518 0.694	1/14. Died 1/23/15. 1/20.
139	62	Myocarditis. Alco- holic cirrhosis	Chronic parenchyma- tous nephritis	200	1.019	S. A.	Pos.	135	0.438	5/8. Cyanosis. Dyspnea.
141	54	Syphilis.....	Chronic interstitial nephritis	Spec.	1.023	M. A.	....	...	0.768	5/12. Delirium. B. P. 190 two years ago. Death 5/20/15.
143	69	Arteriosclerosis. Myocarditis	Arteriosclerotic	Spec.	1.015	S. T.	....	170	0.420 0.768	Pulsus alternans.
152	62	Myocarditis.....	Chronic interstitial nephritis	Spec.	1.030	S. A.	....	220 185	0.480 0.385	Dyspnea. Auricular fibrillation. Large liver.
161	56	Arteriosclerosis. Myocarditis	Arteriosclerotic	Spec.	1.014	T.	....	242	0.336	Edema. Dyspnea.

TABLE 8.—MISCELLANEOUS GENITO-URINARY CASES

No.	Age	Diagnosis	Kidney	Urine				Blood Pressure	Phthal- ein, per Cent.	Blood Urea	Remarks
				Quan., c.c.	Sp. Gr.	Alb.	Blood				
4	78	Prostatic hypertrophy. Cystitis. Acute retention	Chronic interstitial nephritis	Spec.	1.004	S. A.	Pos.	190	20	0.194	1/20. Before operation. 1/21. One day before operation. 1/30. Three days after operation. 2/4. Hiccough, drowsiness. 2/7. Symptoms of uremia. 2/8. 1.008 2/11. 0.864 2/19. 0.714 2/26. 0.360 3/10. 0.354 4/12. 0.108 4/13. Patient went home. 1/30. Old nephritic abscess calcified; drained 1 month previously. Before operation. Two days before operation.
10	54	Cystitis.....	Chronic interstitial nephritis	Spec.	1.008	T.	Neg.	154	70	0.276	
29	28	Pyelonephritis.....	Large right kidney..	500	1.014	T.	Neg.	120	70	0.336	
44	54	Prostatic hypertrophy.....	Chronic interstitial nephritis	1,300	1.008	T.	Neg.	180	75	0.168	
45	56	Hydrocele.....	Negative	Spec.	1.020	T.	Neg.	...	67	0.340	
51	54	Suspected nephrolithiasis	Chronic parenchymatous nephritis	1,200	1.012	M. A.	Pos.	...	47	0.480	
64	24	Post nephrectomy	Mild chronic nephritis	500	1.005	S. T.	....	125	50	0.204	3/ 5/15. 3/14. Nephrectomy four months previous-ly; one-half of horseshoe kidney removed. 3/18. Two days post nephrectomy. 4/10. 0.300 5/ 1. 0.264 3/23. 0.264 4/ 7. 0.264 4/26. 0.384 4/23. 0.393 4/26. 0.444 4/13. 0.444 4/23. One day after thyroidectomy. 4/26. Five days after thyroidectomy. Marked tetany. 4/23. Urea taken. 6/27. Patient still living.
68	50	Pyonephrosis.....	.....	200	1.018	T.	Pos.	126	54 24	0.360 0.516	
75	80	Prostatic hypertrophy	Mild chronic nephritis	Spec.	1.016	T.	....	140	30	0.300	
97	63	Nephrolithiasis....	.....	Spec.	1.012	M. A.	Pos.	137	..	0.264	
99	34	Pyelitis.....	.....	500	1.022	S. T.	....	120	25	0.264	
108	47	Polycystic kidneys	.....	2,200	1.015	M. A.	....	98	..	0.336	
					1.020	S. A.	Pos.	115	57	0.312	
					1.015	M. A.	....	152	T	3.360	

TABLE 9.—DISEASES OF THE HEART

No.	Age	Diagnosis	Kidney	Blood Pressure Per Cent.	Phthal- ein, Per Cent.	Blood Urea	Remarks
26	22	Double mitral.....	Negative.....	130	..	0.252	Old history of rheumatism. Compensation good.
33	17	Double mitral.....	Negative.....	100	75	0.354	Severe tonsillitis and arthritis. Compensation good.
63	60	Double mitral.....	Negative.....	167	72	0.180	Mild decompensation.
109	47	Myocarditis. Pleurisy. Relative mitral insufficiency.....	Negative.....	142	82	0.180	Mild decompensation.
158	56	Myocarditis (mild).....	Negative.....	120	..	0.276	Dyspnea. Chronic cough. Edema of feet. Mild decompensation.
165	64	Myocarditis.....	Negative.....	162	68	0.168	Marked edema of feet. Mild decompensation.
188	45	Myocarditis.....	Negative.....	130	..	0.180	Cardiac asthma.
193	45	Myocarditis.....	Negative.....	103	70	0.300	Dyspnea.
107	45	Myocarditis.....	Negative.....	102	..	0.336	Wassermann two plus. Dyspnea.
201	45	Double mitral.....	Negative.....	120	..	0.204	
203	68	Myocarditis.....	Negative.....	168	..	0.330	Heart markedly dilated. Gastric distress.

TABLE 10.—ANEMIAS

No.	Age	Diagnosis	Kidney	R. B. C. Per c.mm.	Hem. Per Cent.	W. B. C. Per c.mm.	Blood Pressure Per Cent.	Phthal- ein, Per Cent.	Blood Urea	Remarks
31	60	Primary anemia..	Negative.....	1,940,000	45	6,400	119	67	0.456	One year duration.
115	8	Primary anemia..	Paraneurmatous nephritis Alb. Med. Amt.	1,200,000	24	19,400	92	..	0.597	Six weeks' duration. Two days before death.
			Blood.....	660,000	12	18,200	...	..	1.778	Blood, heart ... } 6 hours p. m.
			Hy. casts.....					..	1.680	Pericardial fluid }
132	14	Primary anemia..	Negative.....	550,000	14	3,000	110	..	0.255	Functional heart murmur. Anemia six months' duration.
87	36	Secondary anemia	Negative.....	2,240,000	40	16,100	80	..	0.168	Acute hemorrhage from puncture wound of back.
173	46	Secondary anemia	Negative.....	2,950,000	35	8,000	118	..	0.300	Acute hemorrhage from fibroid uterus. Two weeks' duration.
180	34	Secondary anemia	Chronic interstitial nephritis. Sp. Gr. 1.004 Alb. small amt. Occ. hy. cast.	2,700,000	20	6,200	140	62	0.264	Fibroid uterus. Hemorrhage over period of four years.
185	38	Secondary anemia	Negative.....	2,730,000	35	6,000	150	..	0.168	Fibroid uterus. Hemorrhage over a period of three years.

of the progressive decrease of blood urea to normal, while the phthalein excretion remained small (9 per cent.).

That a high urea can occur without uremic symptoms is shown in Case 134. This case of chronic interstitial nephritis had a blood urea of 1.080 gm. per liter.

One case of diabetic coma with chronic interstitial nephritis had 2.340 gm. per liter, probably as a terminal condition.

The cases on which a phthalein test was made practically all show a distinct decrease along with the rise in blood urea.

ADVANCED CHRONIC NEPHRITIS WITH CARDIAC DECOMPENSATION

The average blood urea in this series of cases was 0.523 gm. per liter, which is higher than the same group of cases without cardiac decompensation, and also distinctly increased above normal value. The blood pressure of all these patients was distinctly elevated. The phthalein was just a trace in two cases, 15 per cent. in another case. Two of the cases with the highest blood urea (0.694 and 0.768 gm. per liter) died shortly after the test was made. Case 141 with a urea of 0.768 gm. per liter was in a fairly good physical condition at time of observation. No normal values were obtained in this group of cases.

MISCELLANEOUS GENITO-URINARY CASES

Twelve miscellaneous cases have been recorded under Table 8. Three cases of prostatic hypertrophy were observed, each having a definite nephritis. One case showed a normal value; the others were increased. Case 4 is interesting in that it shows a rise of blood urea from 0.194 to 0.864 gm. per liter associated with a partial urinary retention progressing to a complete retention. After operation the patient had typical uremic symptoms with a blood urea of 1.008 gm. per liter. As the patient improved the blood urea dropped progressively until a normal value was reached (0.108 gm. per liter). The patient was in fairly good condition at this time.

We found increased urea in cases of nephrolithiasis, pyelonephritis, and pyonephrosis, cystitis, and pyelitis. The cystitis was complicated with chronic interstitial nephritis.

We had under observation a very interesting case of polycystic kidneys (Case 108). Both kidneys were markedly enlarged, the excretion of phthalein was practically nil, and the patient was suffering from chronic uremia. The blood urea was 3.360 gm. per liter, which is the highest value we have obtained in any case. It is remarkable in that the patient is living, three months after the urea examination was made.

DISEASES OF THE HEART

Four cases of double mitral lesions were observed. Three showed normal blood urea. One case had a severe tonsillitis and arthritis and showed a slight increase in blood urea (0.324 gm. per liter). Four of the seven cases of myocarditis were slightly elevated. In no instance did the blood urea increase to 0.400 gm. per liter.

ANEMIAS

Rowntree and Fitz (1913) report a case of splenic anemia with polyserositis with a blood urea of 0.280 gm. per liter.

Tileston and Comfort (1914) obtained normal or only slightly raised blood ureas in two cases of secondary anemia due to hemorrhage and in one case of Banti's disease. In two cases of hemolytic anemia they found marked retention, 0.597 and 0.790 gm. per liter.

We have studied three cases of hemolytic anemia (primary) and four of secondary anemia due to hemorrhage. Two of the cases of secondary anemia had a normal blood urea; the other two cases showed only a mild increase. Two cases of chronic pernicious anemia showed 0.456 gm. and 0.255 gm. per liter, respectively. Case 115 was a very acute pernicious anemia in a child, terminating fatally in six weeks. Two days before death the blood urea was 0.597 gm. per liter; six hours postmortem the urea in heart's blood was 1.778 gm. per liter. He developed a terminal nephritis with many hyaline and blood casts.

LOBAR PNEUMONIA

Tileston and Comfort (1914) report blood ureas on fourteen cases of lobar pneumonia. The highest value was 0.360 gm. per liter, the lowest 0.112 gm. per liter. They believed there was no relation between retention and prognosis. Foster (1915) found a rise in non-protein nitrogen in lobar pneumonia exceptional and associated only with marked circulatory disturbance.

We made forty-two blood urea determinations on twenty cases of lobar pneumonia. These ranged from 0.120 gm. per liter to 1.044 gm. per liter, with an average of 0.405 gm. per liter. In thirty-six of the ureas the values were higher than normal; many of the cases showed a rather marked increase. Some of these patients were cyanosed at the time blood was taken but a number were not. Seventeen of the twenty cases ran a definite toxic nephritis, which probably helped to increase the blood urea. Only one case with a urea of over 0.6 gm. per liter recovered. We believe that in cases with marked increase a bad prognosis should be given. We found in cases of recovery the maximum increase was about the time of crisis, but most of our cases even on the first and second day after onset showed some urea retention. For more details the reader is referred to Table 11.

TABLE 11.—LOBAR PNEUMONIA

No.	Age	Day of Disease	Complications	Blood Pres- sure	Phthal- ein, Per Cent.	Blood Urea	Remarks
6	48	....	Toxic nephritis	137	65	0.120	Temperature 105 F. Recovered.
34	54	4th	Acute toxic nephritis.....	118	..	0.480	Temperature 104 F. Died next day.
36	44	4th	Acute toxic nephritis.....	104	..	0.660	Temperature 105 F. Died next day.
42	24	3d	Mild acute toxic nephritis.....	...	..	0.264	Temperature 104 F. Prompt recovery.
		5th	Mild acute toxic nephritis.....	...	..	0.288	Nephritis cleared up.
52	21	8th	Mild acute toxic nephritis.....	...	..	0.396	Temperature 105 F. Died one day later.
54	34	1st 5th 8th 10th 14th	Acute toxic nephritis plus syphilis.....	108	 37	0.540 0.276 0.540 0.220 0.156	Temperature 105 F. Crisis ninth day. Recovery.
59	34	2d	Negative.....{	92	67	0.156	Temperature 103 F. Recovery.
71	55	7th	Mild acute toxic nephritis.....	99	22	0.624	Temperature 105 F. Died one day later.
73	39	1st 2d 4th 6th	Severe acute toxic nephritis.....	110	.. 37	0.384 0.420 0.372 0.390	Temperature 103 F. Afebrile.
87	43	4th 7th 12th 15th	Mild acute toxic nephritis.....	94 115	 42 ...	0.384 0.228 0.344 0.480	Temperature 105 F. Afebrile. Afebrile. Recovery.
106	28	4th 6th 9th	Mild acute toxic nephritis.....	88 ... 90	55	0.180 0.300 0.156	Temperature 104 F. Recovery.
122	43	5th 9th 16th 20th	Mild acute toxic nephritis.....	112	62	0.360 0.456 0.408 0.300	Temperature 103 F. Afebrile. Recovery. Afebrile. Recovery.
151	37	2d 4th	Severe acute toxic nephritis.....	110 140	38 ..	0.390 0.660	Temperature 105 F. Temperature 105 F. Died on fourth day.
163	30	3d	Acute toxic nephritis.....	112	64	0.444	Temperature 105 F. Died one day later.
164	29	5th 7th	Negative.....	100 110	63 ..	0.420 0.336	Temperature 104 F. Recovery.
169	40	2d 4th 8th	Negative.....	108	78	0.336 0.516 1.044	Temperature 105 F. Marked cyanosis. Died on tenth day.
175	25	2d 6th	Mild acute toxic nephritis.....	100 ...	80 ..	0.336 0.276	Temperature 105 F. Recovery.
178	39	4th	Mild acute toxic nephritis.....	120	68	0.552	Temperature 104 F. Died next day.
181	42	4th 6th 9th	Mild acute toxic nephritis.....	140	70	0.636 0.456 0.420	Temperature 105 F. Recovery.
182	60	8th	Pulmonary tuberculosis	96	80	0.372	Temperature 103 F. Died from tuberculosis later.

TABLE 12.—SEPTICEMIA

No.	Age	Diagnosis	Kidney	Blood Pressure	Phthal- ein. Per Cent.	Blood Urea	Remarks
2	29	Puerperal septicemia (streptococcus)....	Acute toxic nephritis....	...	..	0.924	Death next day.
70	28	Streptococcus septicemia. Knee infection	Acute toxic nephritis....	...	24	0.432 0.516 0.348 0.240 0.308 0.180 0.120	3/19/15. 3/20/15. 3/24/15. 3/30/15. 4/1/15. 4/8/15. 4/10/15. Died two days later from acute hemorrhage due to perforation of vessel.
93	16	Streptococcus peritonitis. Infection from operation	Negative previous to operation	...	..	1.272	4/9/15. Died ten hours later, six days after operation.

TABLE 13.—MENINGITIS

No.	Age	Diagnosis	Kidney	Blood Pressure	Blood Urea	Urea Spinal Fluid	Remarks
110	51	Streptococcus meningitis from otitis media	Negative.....	68	0.708	.....	Patient died seven hours later. Mastoid operation day before.
126	35	Streptococcus meningitis from otitis media	Occult blood, otherwise negative	148	0.370	0.924	Died next day. Streptococcus found in spinal fluid.
130	53	Acute meningitis. ? Meningococcus.....	Negative.....	118	0.228	0.225 0.180 0.120	5/4/15. 1,500 cells per c.c. in spinal fluid. 5/11/15. W. B. C., 20,000; phthalein 62%. 5/20/15. 39 cells per c.c.
187	50	Streptococcus meningitis.....	Acute parenchymatous nephritis	142 ...	 0.384	 0.798	10 a. m. 4 p. m. Phthalein, trace only. Carbuncle. Pleurisy. Died at 5 p. m.

SEPTICEMIA

A single case of puerperal sepsis with recovery we find reported in the literature by Tileston and Comfort, with a normal blood urea.

Three cases of streptococcic septicemia came under our observation, all terminating fatally. Two of these patients developed severe acute toxic nephritis. The urine was not obtained from the third.

In Case 2 of puerperal septicemia the patient had a blood urea of 0.924 gm. per liter, and died within twenty-four hours; Case 93, general peritonitis, a patient with a blood urea of 1.272, died within ten hours; Case 70 had a blood urea of 0.516 gm. per liter on March 20, 1915, which dropped progressively to 0.120 gm. per liter on April 10, 1915, when the patient died from acute hemorrhage.

MENINGITIS

Three cases of streptococcic meningitis and one case of meningococcic meningitis were observed. The three cases of streptococcic meningitis showed definite increase in the urea; that of meningococcic meningitis showed normal urea (Table 13).

ROCKY MOUNTAIN SPOTTED FEVER

Only one case of spotted fever was observed. This was in a patient on the sixth day after onset, with marked petechial eruption, mild delirium and cyanosis. The blood showed 0.690 gm. of urea per liter. At the time there was only a trace of albumin in the urine. The patient died two days later.

TABLE 14.—ROCKY MOUNTAIN SPOTTED FEVER

No.	Age	Urine	Blood Urea	Remarks
154	17	Trace albumin	0.690	Died two days later.

SYPHILIS

Folin and Denis in 1913 reported sixty-three cases. Of these 46 per cent. showed a moderate elevation in blood urea.

Tileston and Comfort (1914) observed eleven cases. Approximately 50 per cent. showed increase of blood urea. They found albumin and casts in practically all of their cases, and concluded that the kidney was affected in a considerable percentage of syphilitics. Nitrogen retention was more evident in the tertiary stage, according to their observation.

Thirty-nine cases of demonstrable syphilis and four cases of clinically suspected syphilis are included in our series and the results are recorded in Table 15.

TABLE 15.—SYPHILIS

No.	Age	Kidney	Blood Pressure	Phthal- ein, Per Cent.	Blood Urea	Stage	Special Symptoms	Wasser- mann	Remarks
171	18	Negative.....	140	..	0.168	1	Primary on lip.....	++	No treatment.
206	34	Negative.....	132	..	0.360	1	.....	—	Primary three days.
119	28	Negative.....	118	..	0.144	2	.....	++	Six salvarsans and mercury.
124	24	Negative.....	155	..	0.264	2	.....	++++	Three salvarsans and mercury.
129	33	.....	130	..	0.360	2	Ulcer tongue	++++	No treatment. Two years' du- ration.
135	40	Mild parenchyma- tous nephritis	118	..	0.312	2	Iritis.....	++	Little treatment.
138	35	Mild chronic inter- stitial nephritis	112	..	0.242	Late 2	.....	+	Infection ten years ago. Well treated then.
141	54	Chronic interstitial nephritis	170	..	0.420	Late 2	Pain.....	+	Primary twenty-one years ago. Little treatment.
142	35	Negative.....	105	..	0.768	Early 2	Adenitis.....	++	Three salvarsans and mercury.
145	30	Negative.....	120	..	0.366	2	Rectal syphilids	+++	No treatment.
146	28	Negative.....	118	..	0.276	2	None.....	+	Four salvarsans. Primary eight years ago.
155	34	Negative.....	135	..	0.240	2	None.....	++	Primary three years. Treatment eight months ago.
166	22	.....	144	..	0.225	2	Mucous patches, mouth and rectum.....	++++	No treatment.
170	32	Negative.....	120	..	0.120	2	Maculopapular eruption	++++	No treatment.
179	28	Negative.....	...	..	0.350	2	No symptoms now.....	—	Five salvarsans and mercury for eight months.
21	41	Negative.....	120	..	0.222	3	Ulcer nasal septum.....	++++	No treatment.
		Negative.....	120	..	0.168	3	.....	+	Four salvarsans and mercury for four months.
67	40	Negative.....	148	..	0.156	3	Ulcer of palate and perforation.....	++	No treatment.
88	28	Negative.....	122	..	0.180	3	Perforation palate	++++	No treatment.
89	25	Negative.....	115	..	0.180	3	Pain in legs.....	+++	No treatment.
92	27	Negative.....	117	70	0.336	3	Hoarseness.....	+++	No treatment.
94	40	Negative.....	...	..	0.240	3	Iritis. Opaque vitreous.....	++++	Two salvarsans two months previously.
98	25	Negative.....	...	..	0.204	3	Acute anisocoria	+	No treatment.
103	30	Negative.....	126	..	0.192	3	Six miscarriages	++++	No treatment.
104	35	Negative.....	142	..	0.204	3	Acute diplopia	++	No treatment.

107	45	Negative.....	102	45	0.338	3	Myocarditis.....	++	No treatment.
111	30	Negative.....	...	..	0.360	3	Diplopia.....	++	Little treatment four years ago.
113	26	Negative.....	145	..	0.324	3	Gumma of clavicle.....	++++	No treatment.
136	33	Chronic parenchymatous nephritis	162	77	0.480	3	Laryngismus stridulus	++	Three salvarsans and mercury.
136	33	Chronic parenchymatous nephritis	...	..	0.360	....	Laryngismus stridulus		
147	25	Negative.....	...	..	0.264	3	Iritis.....	++++	Three salvarsans and mercury.
157	45	Negative.....	142	..	0.348	3	Extra-ocular paralysis	++++	No treatment.
162	24	Negative.....	120	..	0.240	3	.....	++	No treatment.
190	45	Negative.....	140	90	0.256	3	Facial paralysis	+	Four salvarsans and mercury.
199	42	Negative.....	172	..	0.180	3	Anisocoria. Fixed pupils.....	++++	Treatment sixteen years ago.
200	32	Negative.....	120	..	0.216	3	Girdle pain	++	Two salvarsans and mercury.
204	60	Negative.....	132	..	0.216	3	Leukoplakia.....	++++	Two salvarsans four years ago.
23	35	Negative.....	116	..	0.300	Parsis	Reflexes increased. Amnesia. Aphasia...	++	Six salvarsans.
125	49	Negative.....	...	..	0.204	Parsis	Hyper. K. K. Mental deterioration. Argyll Robertson pupils	++++	No treatment.
149	50	Chronic interstitial nephritis	140	..	0.312	Tabes	Absent K. K. Argyll Robertson pupils. Lightning pains	++++	No treatment.
198	41	Negative.....	120	..	0.276	Tabes	Diplopia. Absent K. K. Argyll Robertson pupils. Adentitis (T.B.) Hem. 40%	++++	No treatment.

TABLE 16.—SUSPECTED SYPHILIS

No.	Age	Kidney	Blood Pressure	Phthal- ein, Per Cent.	Blood Urea	Spinal Fluid	Stage	Special Symptoms	Remarks
84	42	Negative.....	150	60	0.312	0.324	3	Cerebrospinal.....	Perforated septum. Arteriosclerosis. Wassermann negative.
79	57	Negative.....	130	..	0.228	0.258	3	Cerebrospinal. Falling spells. Arcus senilis	Wassermann negative in blood and spinal fluid. Two cells per c.mm. spinal fluid.
66	45	Negative.....	...	..	0.144	0.120	3	Vertigo. Gastric disturbances	Wassermann negative in blood and spinal fluid.
205	66	Negative.....	123	..	0.210	....	3	External strabismus. Diplopia	Wassermann negative.

Two cases were primary lues and one of these showed an increase in blood urea. Neither case showed any evidence of kidney pathology.

There were thirteen cases in the secondary stage. Eight showed an elevation of blood urea (i. e., above 0.250). Three of these had a distinct nephritis. Five cases showed an increase above 0.300 gm. per liter, four of whom had practically no treatment for their syphilis.

Twenty cases of the tertiary stage were studied. Eight of these showed an increased urea. But two cases had evidence of a distinct nephritis. Four of the five patients in whom the urea was over 0.300 gm. per liter had received no treatment.

Paresis and tabes dorsalis were each observed in two instances. The urea was elevated in one paretic and in both cases of tabes. One case of tabes had an interstitial nephritis.

SUMMARY

To summarize our observations:

1. Twenty of the thirty-nine cases showed an elevated blood urea (approximately 50 per cent.) ; of the primary stage 50 per cent., secondary 62 per cent., tertiary 40 per cent., and quarternary 75 per cent.
2. But six cases had evidence of a nephritis.
3. Nearly 80 per cent. of the thirteen cases in whom the blood urea was over 0.300 gm. per liter had received no treatment.
4. No relation between the Wassermann test and the amount of blood urea can be drawn.
5. The highest urea was 0.768, a patient who had acquired syphilis twenty years ago, and has now a chronic interstitial nephritis.
6. It is interesting to note that of the cases who received three or more salvarsans, but one was increased above 0.300 gm. per liter.

PULMONARY TUBERCULOSIS

A glance at Table 17 will show that in two cases out of seven, there was an increase in blood urea. Case 121, an acute miliary tuberculosis, with a severe acute toxic nephritis, had 0.600 gm. urea per liter, and terminated fatally. Case 123, a chronic advanced tuberculosis, was slightly raised (0.288 gm. per liter), and had a mild parenchymatous nephritis. Other authors have observed retention in cases of tuberculosis (Tileston and Comfort).

DIABETES MELLITUS

Seven cases of diabetes mellitus are included in our series (see Table 18). Five of these were complicated with chronic nephritis. Three of the cases showed definite increase in blood urea. They were all cases with nephritis. Case 184 had urea 0.336 gm. per liter on admission to the hospital. Two days later he developed coma and had a blood urea of 2.340 gm. per liter. He died the following day.

TABLE 17.—PULMONARY TUBERCULOSIS

No.	Age	Stage of Disease	Kidney	Blood Pressure	Phthal- ein, Per Cent.	Blood Urea	Remarks
24	40	Mild chronic.....	Negative.....	120	45	0.150	Twenty years' duration.
121	32	Acute miliary.....	Acute toxic nephritis....	110	T.	0.600	Temperature 103 F. Died.
123	45	Chronic advanced.....	Mild parenchymatous ne- phritis.....	100	87	0.288	Temperature 100 F. Syphilis compl- cating.
168	50	Chronic advanced.....	Negative.....	104	..	0.132	
192	25	Chronic advanced.....	Mild parenchymatous ne- phritis.....	...	..	0.120	
209	35	Chronic.....	Negative.....	145	..	0.180	Marked ascites two weeks' duration. Tu- berculous peritonitis. Temp. 102 F.

TABLE 18.—DIABETES MELITUS

No.	Age	Sugar, Per Cent.	Diabetic Acetone	Kidney	Blood Pressure	Phthal- ein, Per Cent.	Blood Urea	Remarks
9	43	5 Neg.	Present..... Negative.....	Negative..... Negative.....	130 ...	.. ..	0.264 0.120	Carbohydrate free diet.
14	54	T.	Negative.....	Negative.....	180	..	0.162	
20	57	2	Negative.....	Mild chronic interstitial nephritis.....	154	..	0.150	Sugar free on 60 gm. white bread.
48	51	0.5	Negative.....	Chronic interstitial nephritis.....	168	55	0.144	Four years' duration. Mild arteriosclero- sis.
172	58	1.3	Present.....	Chronic interstitial nephritis.....	...	..	0.362	Gangrene foot.
184	42	5	Present.....	Chronic interstitial nephritis.....	150	75	0.336	
		5	Present.....	Chronic interstitial nephritis.....	150	..	2.340	In coma. Died on following day.
202	54	5	Present.....	Chronic interstitial nephritis.....	242	65	0.300	

TABLE 19.—DISEASES OF THYROID

No.	Age	Diagnosis	Kidney	Blood Pressure	Phthal- ein, Per Cent.	Blood Urea	Remarks
72	20	Exophthalmic goiter.....	Negative.....	120	82	0.264 0.324 0.180	Before operation 3/25/15. Shortly after operation 3/30/15. After operation 4/5/15.
65	32	Exophthalmic goiter.....	Negative.....	110	74	0.240 0.144 0.120	Before operation 3/15/15. After operation 3/20/15. After operation (leaving hospital) 3/30/15.
30	32	Exophthalmic goiter.....	Negative.....	135	55	0.276	Before operation.
3	50	Hypothyroidism. Arteriosclerosis.....	Arteriosclerotic kidney..	250	..	0.096 0.118	Having thyroid extract treatment for six months. Weakness, dyspnea and tachycardia.
160	31	Colloid goiter.....	Negative.....	170	..	0.504	

TABLE 20.—MALIGNANCY

No.	Age	Diagnosis	Kidney	Blood Pressure	Blood Urea	Urea Fluid	Remarks
55	60	Recurrent papilloma of ovary.....	Negative.....	...	0.262	0.426 0.480	Ascites. Palpable abdominal mass.
90	28	Malignant pleura.....	.....	136	0.204	0.240	Ascites. Jaundice.
91	40	Adenocarcinoma stomach.....	Mild parenchymatous nephritis	...	.....	0.204 0.258 0.348	Taken just before death.
128	50	Extensive carcinoma of face.....	Negative.....	150	0.276	.....	Wassermann.
150	58	Adenocarcinoma stomach.....	Negative.....	115	0.648	.....	Before operation. Persistent vomiting.
207	50	Sarcoma of hip.....	Negative.....	160	0.408	.....	Before operation.

TABLE 21.—MISCELLANEOUS

No.	Age	Diagnosis	Kidney	Blood Pressure	Phthal. eln. Per Cent.	Blood Urea	Fluid Urea	Remarks
12	55	Acute obstruction (malignant).....	Acute toxic nephritis	...	..	1.350	.....	Died one day later. Inducanuria.
13	29	Acute obstruction (? etiology).....	Negative.....	...	..	0.336 1.080 0.714	.....	2/1/15. Condition good. 2/5/15. After operation. 2/6/15. Died two days later.
17	46	Acute obstruction. Incarcerated hernia	Negative.....	115	..	0.360	.....	2/ 5/15. Six days after operation. Recovery.
25	26	Psoriasis.....	Negative.....	123	..	0.246	.....	2/12/15. Chronic.
53	23	Urticaria.....	.....	...	..	0.168	.....	First day of rash.
81	38	Pityriasis rosea.....	Negative.....	125	..	0.216	.....	Fourth day of rash.
61	21	Second degree burn (steam).....	Negative.....	...	..	0.132	0.108	Two days' duration.
100	45	Second degree burn (gas).....	Negative.....	...	..	0.258	0.242	Three days' duration.
19	38	Fractured skull.....	Negative.....	110	..	0.254	.....	2/ 8/15. One day after injury.
96	46	Cerebral hemorrhage.....	Glucose T.....	...	..	0.300	.....	2/11/15. No coma.
116	28	Concussion.....	Alb. L. A.....	190 260	..	0.336	.....	Blood pressure raised 70 mm. in 2 hours. Death five hours after hemorrhage.
78	54	Gout.....	Negative.....	156	..	0.426 0.336	.....	Patient comatose. Fourteen days later, conscious.
144	39	Obstruction common duct (postoperative)	Negative.....	130	67	0.288	.....	
159	51	Obstruction common duct (postoperative)	Alb. T.....	125	13	1.512	.....	5/10. Complete obstruction.
62	39	Epilepsy.....	Many casts.....	125	13	1.560	.....	5/11. Vomiting, not severe.
27	56	Traumatic pleurisy.....	Alb. T.....	132	56	0.336	.....	5/14. Duct opens.
112	23	Esophageal stenosis. Gunshot wound	Occ. hy. cast.....	...	..	0.168	.....	5/29.
140	46	? Intracranial tumor.....	Negative (bile).....	...	60	0.144	.....	6/ 2.
148	24	Chronic arthritis.....	Negative.....	108	..	0.408	.....	Jaundice.
153	54	Arteriosclerosis.....	Negative.....	150	T.	0.156	.....	Attack grand mal day previous.
167	23	Bone cyst (jaw).....	Negative.....	88	..	0.354	.....	General anasarca; marked cyanosis. 0.540 pleuritic fluid urea. Died four days later.
189	43	Neurosis.....	Negative.....	132 145	..	0.486	.....	Gastrostomy done six days previously. Marked anemia. Died same day urea was taken.
194	40	Aneurysm.....	Negative.....	...	..	2.268 2.316	.....	Choked disk, extra-ocular palsy, headache. Wassermann negative. Marked ankle clonus. Hyper K. K. Comatose three days later.
208	60	Arteriosclerosis.....	Negative.....	122	..	0.240	.....	
			Negative.....	190	..	0.276	.....	Menopause.
			Arteriosclerotic.....	...	..	0.394	.....	Wassermann negative.
			Negative.....	140	..	0.264	.....	Mild arteriosclerosis.
			Negative.....	102 L. 145 R. 240	..	0.356	.....	Large sac arch of aorta. One year's duration.
			Negative.....	...	..	0.180	.....	Diplopia and headache.
			Negative.....	...	..	0.292	.....	
			Negative.....	...	..	0.360	.....	

DISEASES OF THE THYROID

We made blood urea determinations on three cases of exophthalmic goiter. All showed a urea slightly above normal before operation. Following operation the urea dropped to normal. We studied only one case of myxedema. The patient had in addition marked arteriosclerosis. Two determinations of urea were made, both of which were slightly below normal.

Case 160 was a patient with a large colloid goiter who had taken thyroid extract for six months. He showed marked hyperthyroidism. His blood urea was increased to 0.504 gm. per liter.

The phenolsulphonephthalein output in all three cases of exophthalmic goiter was normal or slightly increased in amount.

MALIGNANCY

A series of six cases was studied, the results of which are shown in Table 20. Two cases show slight increase. Cases 150 and 207 show a distinct elevation, 0.648 and 0.408 gm. per liter, respectively. Neither case had any clinical evidence of nephritis. This observation is not in accord with the conclusion of Tileston and Comfort, who stated that no changes were met with in malignant disease which could not be ascribed to a complicating renal disease.

MISCELLANEOUS

We have studied twenty-four miscellaneous conditions. Four cases of intestinal obstruction had an increased blood urea. Cases 12 and 13 showed very high values, 1.380 and 1.080 gm. per liter, respectively. One case of obstructed bile duct, complicated with parenchymatous nephritis, showed 1.560 gm. per liter, but dropped promptly to normal as soon as the obstruction was relieved. Case 112 gave marked urea increase, 2.311 gm. per liter. The patient had an esophageal stenosis.

Slightly raised values were found in urticaria, fracture of the skull, cerebral hemorrhage, cerebral concussion, traumatic pleurisy, bone cyst, arteriosclerosis, and chronic arthritis. Normal values were obtained in psoriasis, pityriasis rosea, epilepsy, and a functional neurosis.

THE UREA CONTENT OF BODY FLUIDS

A most excellent summary of the literature on the subject is included in the work of Soper and Granat (1914). To that article the reader is referred.

Soper and Granat studied the urea content in the spinal fluid in ninety-seven cases. They found that the amount of the urea in the spinal fluid usually agreed with that in the blood. Most of the variations were due to the difference in time of taking of the fluids.

TABLE 22.—UREA CONTENT IN BODY FLUIDS

No.	Diagnosis	Fluid	Fluid Urea	Blood Urea
51	Chronic nephritis.....	Spinal.....	0.166	0.210
84	? Syphilis.....	Spinal.....	0.324	0.312
74	Paresis.....	Spinal.....	0.270	.....
54	Syphilis.....	Spinal.....	0.390	0.540
79	Syphilis.....	Spinal.....	0.258	0.228
66	Syphilis.....	Spinal.....	0.120	0.144
125	Paresis.....	Spinal.....	0.204	0.198
126	Meningitis.....	Spinal.....	0.324	0.370
130	Meningitis.....	Spinal.....	0.255	0.288
140	? Brain tumor.....	Spinal.....	0.204	0.240
130	Meningitis.....	Spinal.....	0.180	.....
162	Cerebrospinal syphilis.....	Spinal.....	0.198	0.240
130	Meningitis.....	Spinal.....	0.120	.....
183	Chronic nephritis.....	Spinal.....	0.240	0.204
187	Meningitis.....	Spinal.....	0.798	0.384
191	Chronic nephritis.....	Spinal.....	0.596	0.396
198	Tabes dorsalis.....	Spinal.....	0.264	0.276
89	Syphilis.....	Spinal.....	0.216	0.180
210	Bulbar paralysis.....	Spinal.....	0.120	.....
55	Ovarian tumor (malignant).....	Peritoneal.....	0.426	0.262
91	Carcinoma of stomach.....	Peritoneal.....	0.204	.....
91	Carcinoma of stomach.....	Peritoneal.....	0.258	.....
91	Carcinoma of stomach.....	Peritoneal.....	0.348	.....
55	Ovarian tumor.....	Peritoneal.....	0.480	.....
209	Tubercular peritonitis.....	Peritoneal.....	0.180	0.180
57	Ovarian tumor.....	Cyst.....	0.432	0.233
131	Ovarian tumor.....	Cyst.....	0.216	0.192
137	Ovarian tumor.....	Cyst.....	0.168	0.156
45	Hydrocele.....	.....	0.276	0.340
120	Hydrocele.....	.....	0.484	.....
61	Second degree burn.....	Vesicle.....	0.108	0.132
100	Second degree burn.....	Vesicle.....	0.242	0.288
27	Pleurisy.....	Pleural.....	0.540	0.496
90	Malignant pleura.....	Pleural.....	0.240	0.204
115	Anemia.....	Pericardial.....	1.680	1.778
211	Gonorrheal arthritis.....	Joint fluid.....	0.240	0.240

TABLE 23.—PHTHALEINS

Case Number	Per Cent. Phthalein 2 Hrs.	Blood Urea	Case Number	Per Cent. Phthalein 2 Hrs.	Blood Urea
196	65	0.108	202	65	0.306
41	82	0.120	29	70	0.306
6	65	0.120	84	60	0.312
197	70	0.120	99	57	0.312
40	67	0.156	80	60	0.326
59	67	0.156	33	75	0.324
137	82	0.156	85	42	0.324
77	65	0.160	114	80	0.324
165	68	0.168	92	70	0.336
144	56	0.168	107	45	0.336
38	72	0.168	116	67	0.336
39	87	0.168	169	73	0.336
44	75	0.168	175	80	0.336
48	55	0.144	156	75	0.336
5	15	0.180	184	75	0.336
60	40	0.180	45	67	0.340
63	72	0.180	27	T	0.354
106	55	0.180	68	54	0.360
100	82	0.180	95	37	0.360
132	66	0.182	122	62	0.360
58	50	0.192	151	38	0.360
131	68	0.192	136	77	0.360
125	15	0.198	182	80	0.372
183	67	0.204	76	50	0.396
195	50	0.204	28	55	0.408
83	60	0.216	150	60	0.408
82	42	0.222	73	37	0.420
162	73	0.240	164	63	0.420
105	70	0.242	70	40	0.432
176	82	0.252	139	T	0.438
190	95	0.256	163	64	0.444
130	65	0.228	31	67	0.456
64	50	0.264	97	25	0.444
71	82	0.264	51	47	0.480
101	65	0.264	156	38	0.516
68	30	0.264	54	37	0.540
180	62	0.264	105	60	0.546
30	55	0.276	178	68	0.552

TABLE 23.—PHTHALEINS—(Continued)

Case Number	Per Cent. Phthalein 2 Hrs.	Blood Urea	Case Number	Per Cent. Phthalein 2 Hrs.	Blood Urea
32	63	0.270	121	T	0.600
10	70	0.276	71	22	0.624
35	65	0.280	181	70	0.636
50	77	0.288	156	50	0.672
78	67	0.288	1	15	0.694
87	42	0.288	156	26	0.720
123	87	0.288	144	20	0.936
152	T	0.285	4	20	1.008
11	95	0.294	144	13	1.560
193	70	0.300	108	T	3.360

They quote the work of Javal as establishing the fact that the urea content of body fluids, edema, pleural and ascitic, equals in amount the blood urea. They found the normal urea in spinal fluid between 0.01 per cent. and 0.05 per cent.

Cullen and Ellis³⁶ (1915) have shown that when the blood and spinal fluid are drawn at about the same time the difference in the amount of urea in the two fluids is rarely greater than 2 mg. per 100 c.c.

We have made comparative urea determinations on the body fluids and blood of twenty-eight different patients. Of these nineteen were spinal and six were peritoneal fluids. Table 23 shows the results, and they will be seen to correspond closely with those obtained by Soper and Granat. In the main the blood urea equals the fluid urea. Cases 54, 55, 57, 187 and 191 show rather marked differences. The fluids and blood from Cases 54, 55 and 57 were taken within a few minutes of each other. The fluids from Cases 55 and 57 were from very thick-walled ovarian cysts. The fluids from Cases 187 and 191 were taken at different times from the blood.

CONCLUSIONS

1. In the normal fasting adult the blood urea varied from 0.108 to 0.252 gm. per liter.
2. The majority of cases of acute nephritis show an increased urea.
3. In mild chronic nephritis there is a normal or slightly elevated amount of blood urea. Cases of advanced chronic nephritis have a distinct increase. The effect of an associated cardiac decompensation is to further elevate the blood urea.

36. Cullen and Ellis: Jour. Biol. Chem., 1915, xx, 511.

TABLE 24.—BLOOD PRESSURES *

Case No.	Age	Blood Pressure	Blood Urea	Case No.	Age	Blood Pressure	Blood Urea
110	51	68	0.708	122	43	112	0.360
37	36	80	0.168	122	43	112	0.456
106	28	88	0.180	138	35	112	0.242
112	23	88	2.316	150	58	112	0.648
106	28	90	0.156	163	30	112	0.444
59	34	92	0.156	17	46	115	0.246
115	8	92	0.596	89	25	115	0.180
87	43	94	0.384	99	34	115	0.312
182	60	96	0.372	23	35	116	0.390
97	53	98	0.336	47	24	116	0.192
128	45	100	0.288	92	27	117	0.336
122	43	100	0.408	34	48	118	0.480
164	29	100	0.420	119	28	118	0.144
33	17	100	0.324	130	53	118	0.228
33	23	100	0.168	135	40	118	0.312
58	22	100	0.192	146	..	118	0.276
39	21	102	0.168	173	46	118	0.300
70	28	102	0.120	31	60	119	0.456
107	45	102	0.336	32	20	119	0.270
175	25	102	0.336	24	40	120	0.150
193	45	103	0.300	29	..	120	0.336
168	50	104	0.132	21	41	120	0.222
36	44	104	0.660	72	20	120	0.264
142	..	105	0.288	95	27	120	0.360
137	25	106	0.156	97	53	120	0.444
54	34	108	0.540	101	55	120	0.264
62	39	108	0.156	145	..	120	0.336
169	40	108	0.336	158	56	120	0.276
19	88	110	0.384	162	24	120	0.240
35	23	110	0.280	170	32	120	0.120
69	21	110	0.108	178	39	120	0.552
70	28	110	0.432	195	20	120	0.204
78	34	110	0.420	197	23	120	0.120
121	..	110	0.600	198	41	120	0.276
133	14	110	0.255	200	32	120	0.216
151	37	110	0.360	201	..	120	0.204
122	43	110	0.300	40	21	122	0.156
11	..	112	0.288	41	21	122	0.120

* Blood pressures are systolic.

TABLE 24.—BLOOD PRESSURES *—(Continued)

Case No.	Age	Blood Pressure	Blood Urea	Case No.	Age	Blood Pressure	Blood Urea
50	67	122	0.288	151	37	140	0.660
88	28	122	0.180	171	18	140	0.168
148	..	122	0.394	181	42	140	0.636
176	..	122	0.252	189	43	140	0.180
25	26	123	0.168	190	45	140	0.256
81	38	125	0.216	104	..	142	0.204
144	39	125	1.512	109	47	142	0.180
60	22	126	0.180	130	53	142	0.180
68	50	126	0.360	157	45	142	0.348
103	..	126	0.192	166	22	144	0.225
205	35	128	0.210	113	26	145	0.324
129	33	130	0.360	140	46	145	0.276
156	32	130	0.672	194	..	145	0.264
26	22	130	0.252	209	35	145	0.180
78	54	130	0.288	67	40	148	0.156
79	57	130	0.228	126	35	148	0.370
102	35	130	0.336	7	72	150	0.084
140	46	132	0.240	22	16	150	0.372
189	62	132	0.438	84	42	150	0.312
144	39	132	1.560	128	50	150	0.276
9	43	130	0.264	184	42	150	0.336
188	45	130	0.180	108	47	152	3.360
196	26	132	0.108	27	56	150	0.354
206	34	132	0.360	16	33	154	0.324
204	60	132	0.216	20	67	154	0.150
28	33	134	0.408	10	54	154	0.276
127	65	134	0.240	131	37	154	0.192
156	32	134	0.720	124	24	155	0.264
8	54	135	0.210	15	27	156	0.228
30	32	135	0.276	116	28	156	0.426
155	34	135	0.240	207	50	160	0.408
90	28	136	0.204	134	47	162	1.080
6	48	137	0.120	136	33	162	0.480
75	80	137	0.264	165	64	162	0.168
105	47	138	0.546	43	51	168	0.144
180	34	138	0.264	114	60	168	0.324
149	50	140	0.312	203	68	168	0.380
68	50	140	0.264	86	46	170	0.348

TABLE 24.—BLOOD PRESSURES *—(Continued)

Case No.	Age	Blood Pressure	Blood Urea	Case No.	Age	Blood Pressure	Blood Urea
141	54	170	0.420	96	46	190	0.396
160	31	170	0.504	153	54	190	0.264
199	42	172	0.180	191	58	204	0.396
47	..	178	0.242	85	60	208	0.324
14	57	180	0.150	143	60	220	0.480
44	56	180	0.168	18	55	230	0.276
132	46	180	0.182	56	65	240	0.414
105	47	180	0.242	208	60	240	0.360
152	62	185	0.285	161	56	242	0.336
174	67	186	0.264	22	54	242	0.300
i	75	190	0.604	3	50	250	0.096
4	78	190	1.008	5	26	250	0.240
46	55	190	0.288	76	29	250	0.396

4. A high value occurring with a transient mechanical obstruction of the urinary tract does not necessarily mean a bad prognosis.

5. In polycystic kidneys, with a very large amount of blood urea, and low phthalein excretion, the outcome may not be immediately fatal.

6. The majority of cases of lobar pneumonia have a raised value. A bad prognosis should be given in those cases which show considerable increase.

7. Approximately one-half of the cases of syphilis show a distinct elevation.

8. In exophthalmic goiter there is an increase, and in myxedema, a decrease in blood urea.

9. In primary anemia, nephrolithiasis, pyelonephritis, pyonephrosis, septicemia, streptococcic meningitis, Rocky Mountain spotted fever, pulmonary tuberculosis, diabetic coma, intestinal obstruction, malignancy, and common duct obstruction, we find a definite increase in most of the cases.

10. A slight elevation occurs in valvular heart lesions, myocarditis, secondary anemia, urticaria, fractured skull, cerebral hemorrhage, concussion, bone cyst, traumatic pleurisy, arteriosclerosis and chronic arthritis.

11. No changes were found in psoriasis, pityriasis rosea, epilepsy, meningococcic meningitis, diabetes and functional neurosis.

12. The urea content of body fluids, in the majority of cases, agrees with the blood urea.

13. The blood pressure was taken in 178 cases. Reference to the results, as given in Table 24, will readily show that there is no relation between blood pressure and the amount of blood urea.

14. The results of phthalein excretion in ninety-six cases agree with the observation of others, who find in most cases the percentage of phthalein excreted is diminished along with increase in blood urea (Table 23).