

CLINICAL CALORIMETRY

TWENTY-SECOND PAPER

THE RESPIRATORY METABOLISM IN NEPHRITIS *

JOSEPH C. AUB, M.D., AND EUGENE F. Du BOIS, M.D.

WITH THE TECHNICAL ASSISTANCE OF G. F. SODERSTROM

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A study of the syndrome known as *nephritis* should throw a great deal of light on many problems of normal and pathologic physiology. The disease is accompanied by profound changes of long duration, and the organism is obliged to adapt itself to conditions which are very different from those found in health. For this reason the investigator can obtain in the study of nephritis much information as to the manner in which the total metabolism is influenced by certain factors. Chief among these are nitrogen retention, edema, high blood pressure, acidosis and the conditions which cause uremia. Unfortunately, we know little about these factors, and suspect the presence of many more about which we know nothing. At this stage, all that one can do is to present his findings as completely as possible in the hope that they will be of service to those who can some day solve the nephritis problem. In the meantime, the study will help in the solution of many related questions.

The basal metabolism of patients with cardiac and renal disease was discussed briefly in Paper 16 of this series. The literature was reviewed and the results obtained on sixteen patients were published in such detail as was possible. Some of these patients had been studied in the early days of the calorimeter, before the general recognition of the importance of many of the modern measurements and tests. In most of the patients studied the cardiac element predominated, but in about half there was an important nephritic element also. It was found that the total metabolism of patients with mild cardiac or renal disease was normal, and that five of the twelve patients with dyspnea showed an increase in metabolism of 25 to 50 per cent. The respiratory quotients were all within normal limits and the method of direct calorimetry gave results only 1.9 per cent. lower than the method of indirect calorimetry. No direct relationship was found between the level of the metabolism and the acidosis, height of blood pressure or the ability of the kidney to excrete phenolsulphonephthalein. In

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* From the Russell Sage Institute of Pathology, in affiliation with the Second Medical Division, Bellevue Hospital.

Table 2 of Paper 16 the results of the clinical and laboratory findings were compared.

This present work is a continuation of Paper 16 and Tables 2 and 3 have been made to correspond as closely as possible with Table 2 of the previous publication. More attention has been given to blood analyses, the methods for estimating the degree of acidosis, and the functional capacity of the kidneys. The patients were all primarily nephritics and were selected from a large number in the effort to obtain young people with few complications. For the first time since the calorimeter work was begun, patients with an absolutely bad prognosis were used as subjects.

METHODS

The men patients were studied in the metabolism ward and calorimeter fully described in previous papers. The two women patients could not be brought to the metabolism ward, and it was impossible to study their intake and output, but otherwise they were treated in just the same manner as the men. Patients with orthopnea were placed in the steamer chair while in the calorimeter; all others used the bed, with head rest and pillow. Most of the patients were given a cup of "caffeine-free" coffee (Kaffee Hag) without cream or sugar, early in the morning of the experiment. Except for this they were all fasting, having received no food since the previous afternoon. While in the apparatus they were all quiet, except the uremic patients, Isadore R. and Frank C.

The blood pressure was measured by the Faught apparatus, diastolic readings being made at the diminution of the murmur in the artery, which usually occurs just before its disappearance. The phenolsulphonephthalein test of Rowntree and Geraghty was used, the results in the tables being expressed as the total excretion in two hours and ten minutes. The carbon dioxide combining capacity of the plasma was determined by the Van Slyke method.

The blood and urinalyses, while the patients were in the metabolism ward, were made by Dr. Frank C. Gephart of the staff of the Russell Sage Institute of Pathology. While the patients were in the general medical wards the analyses were made, for the most part, in the Pathological Department of Bellevue Hospital by Drs. A. O. Gettler and Willis Baker. To them and to Dr. Norris we are indebted for permission to publish the results. These authors have recently published a valuable contribution on the "Chemical and Physical Analysis of Blood in Thirty Normal Cases."¹

DISCUSSION OF RESULTS

The manifestations of nephritis are so varied that it will require the study of many cases to give all the information that is needed. Nevertheless, much can be learned from the ten cases summarized in Table 2 and the sixteen cases of the previous publication. (See, Table 2, Paper 16).

Direct and Indirect Calorimetry.—In the thirteen² experiments here reported the total calories, as measured by the method of indirect

1. Gettler, A. O., and Baker, Willis: Jour. Biol. Chem., 1916, **25**, 211.

2. The experiment on Mildred C. is omitted because the direct method could not be used.

calorimetry, was 1,700.4; by the method of direct calorimetry, 1,743.3, or 2.5 per cent. higher. In the previous work, the calories by the indirect method totaled 4,297.7, and by the direct method, 4,214.5, which was 1.9 per cent. lower. These two divergences of the direct calorimetry almost neutralize each other, and in the grand total of all the work the indirect is 5,998.1; the direct, 5,957.8, which is 0.7 per cent. lower. This agreement is just as close as in the case of a group of normal controls, and it shows that the calorific value of one liter of oxygen is the same in nephritics and normals. We must not forget, however, that there may be striking changes in the intermediary metabolism without great change in the calorific value of oxygen. This is brought out clearly in the work on diabetes.

Respiratory Quotients.—Except in the cases of diabetes and in convalescence, the respiratory quotient fourteen hours after the last meal is little more than the expression of the amount of carbohydrate available in the organism. This depends on the state of nourishment, the amount of carbohydrate food taken the preceding day, and the level of the total metabolism which determines the rate at which this carbohydrate is oxidized. Nephritic patients, as a rule, are given carbohydrate diets unless the total calories are greatly restricted. It is not surprising, therefore, that quotients as high as 0.93 and 0.89 were found. On the other hand, the lowest quotients obtained, 0.77 and 0.78, are well within normal limits. This confirms the statement made a year ago that there is no need to assume any change in the type of the metabolism from the normal.

Total Metabolism.—The calculations of the total metabolism are based on the measurements obtained by the method of indirect calorimetry and are expressed as calories per square meter of surface per hour. This figure is then compared with the standard average normal figure for the same age and sex, as given in Table 7 of Paper 13 of this series, and the percentage variation from the normal recorded. Most of the subjects could be compared with the group of normal men between the ages of 20 and 50, the average calories per square meter per hour being 39.7. The results obtained on John C., 62 years old, were compared with the figure 37, which is about the average for his time of life according to the revised curve given in Paper 19. This makes him 10 per cent. above the normal. He still had his youthful vigor, and it is well to remember that his metabolism was only 3 per cent. above the standard for men 20 to 50 years of age. Edna S. presents a different problem. She was only 13 years old, and the standard for girls of this age is 47 calories per square meter per hour. For two months before the calorimeter observation she had been on a restricted

diet, and this may reduce the metabolism even more in a child than in an adult. Direct evidence on this point is lacking, but it can be seen in Table 9 of Paper 17 that the four children with severe diabetes show an unusual reduction in metabolism. The observation on Frank C., with uremia, was almost spoiled by his restlessness, which was even greater than is indicated by the high work-adder. The results were 29 per cent. above the basal standard, but those who observed him were confident that his muscular activity alone could have increased his metabolism 20 to 30 per cent., and it is doubtful if his basal metabolism would have been higher than the average normal. It is unfortunate that the otherwise satisfactory experiment on Mildred C. should be marred by the possibility that she had exophthalmic goiter. Her nervous temperament and exophthalmos, which was greater than is generally found in nephritis, suggested this factor.

A. Influence of Dyspnea.—Isidore R., Frank C., and John C. were distinctly dyspneic, and they all showed a slight increase in metabolism. This increase was not as marked as in the four out of five patients with moderately severe dyspnea described in the paper on cardiacs and nephritics.

B. Acidosis.—According to the carbon dioxid combining capacity of the plasma, a rather severe type of acidosis was present in the case of Joseph U. on April 5, and in Isidore R. on January 24. The former showed a metabolism of 7 per cent. below the normal; the latter, only 2 per cent. above. Slight acidosis was found in Joseph U. on April 10, and in Jack K. on March 4. Their figures were —12 per cent. and +5 per cent., respectively. These results, taken with the figures obtained in Papers 16 and 17, indicate that acidosis has little effect on the total metabolism.

C. Edema.—There was marked edema in the cases of Joseph U., Lee H., Edna S. and William S. The first three showed a distinct reduction in metabolism. With Adam P., January 14, the edema was moderate and the metabolism 10 per cent. below the average normal. In general, the type of nephritis with edema is accompanied by a reduction in metabolism; the type without edema, by a slight increase in metabolism. One naturally expects an organism diluted by inert fluid to show a diminished metabolism according to body weight. Obesity patients have such a reduction, but Means has proved that they have the same metabolism per square meter of surface as normal people.³

3. Means, J. H.: Studies of the Basal Metabolism in Obesity and Pituitary Disease, *Jour. Med. Research*, 1915, **32**, 121; The Basal Metabolism in Obesity, *THE ARCHIVES INT. MED.*, 1916, **17**, 704.

Edematous cardiac patients as a rule show an increased metabolism, but here other factors may be involved. The reduction of metabolism per square meter of surface found in nephritic edema is sometimes very marked (—27 and —40 per cent.), and it points to some cause other than mere dilution of tissue and distention of skin.

D. High Blood Pressure.—All the patients except Lee H. showed a rise in blood pressure. The systolic pressure was above 200 mm. in the cases of Adam P., January 14, Isidore R., Frank C., John C. and Mildred C. Of these, Adam P. showed a reduced metabolism and the others an increase. With Adam P. the metabolism was about the same when his systolic pressure was 185 mm. as when it was 230 mm. George M., of Paper 16, showed exactly the same figures for a blood pressure of 160 mm. as for a pressure of 195 mm. On the other hand, Joseph U. showed a drop in metabolism when his blood pressure fell. Blood pressure has no constant influence on the total metabolism.

E. Eliminative Power of the Kidney.—Curiously enough, most of the patients were able to eliminate at least 6 gm. of nitrogen in the urine on the calorimeter days, and Lee H. was the only one, except the incontinent patients, Isadore R. and Frank C., in whom the urine volume was much diminished. On the other hand, the chlorid elimination was low in most of the patients, probably on account of the low intake in some cases, but in most on account of inability on the part of the kidney to excrete salt. The phthalein output was low in all cases except Joseph U. on April 5, and Lee H. on December 4. The Ambard coefficient expressed in terms of the McLean index was low in the cases of Joseph U. and Frank C.

The nonprotein nitrogen was above the normal limits in the cases of Joseph U., Jack K., Isidore R., Frank C.; and the urea nitrogen was above normal in Lee H. also. One of these patients showed a decrease in metabolism, the others a slight increase. In general, it does not seem that the products retained by damaged kidneys have any direct effect on the level of the total metabolism.

CHANGES IN INDIVIDUAL CASES

Joseph U. was in the calorimeter three times, and during the whole period there was little change in the McLean index and blood urea. In the first experiment his metabolism was higher than normal. In the next week he lost 5 kg. of edema and his metabolism fell to 7 per cent. below the normal average. At this time he had a distinct acidosis and furnished an excellent opportunity to study the effect of this factor on metabolism. Accordingly, he was given sodium bicarbonate until the acidosis almost disappeared and there was scarcely any change in his metabolism.

Lee H. was studied, December 4, and again a month later, when he had gained 5.5 kg. of edema. During this same period there was a marked fall in the phthalein output and increase in the retention of urea and creatinin. His metabolism in the first test had been 12 per cent. below the average normal; a month later it was 27 per cent. below. Part of this decrease was undoubtedly due to rest and low diet.

Adam P. was in the calorimeter January 14 and again three and a half weeks later, when he had lost 8 kg. of edema. In this interval there was practically no change in the phthalein excretion or in the blood urea, but the blood pressure fell 45 mm. There was hardly any alteration in the level of his total metabolism.

SUMMARY AND CONCLUSIONS

Ten patients with nephritis were studied in the calorimeter. All were severe cases, and it was possible to examine five of the patients shortly before death. The results have been compared with those obtained last year on a series of patients with cardiorenal disease, six of whom were primarily nephritics.

In the present series nine experiments were made on edematous subjects. All but two of these tests showed a diminution of the basal metabolism, both according to body weight and to surface area. In two cases with great edema the heat production was 27 and 40 per cent. below the normal average.

Five patients suffering from nephritis of the chronic interstitial type, without edema, were studied. One with marked uremia was at the normal level of metabolism. Another, who was very restless, showed an increase. A third, in whom hyperthyroidism was suspected, also showed an increase. The other two were near the upper normal level of metabolism.

In most of the patients with greatly increased blood pressure the metabolism was higher than in the other nephritics with lower blood pressures. Most of the patients with marked dyspnea showed some increase in metabolism. No relationship could be established between the level of metabolism and the degree of acidosis or the eliminative power of the kidney, as estimated by the McLean index, the phenol-sulphonphthalein test, the elimination of salt and nitrogen, and the analysis of the various substances in the blood, such as chlorids, urea, and the nonprotein nitrogen.

The methods of direct and indirect calorimetry in this and the previous series of cardionephritics give totals which agree within 0.7 per cent. The respiratory quotients are all within normal limits, showing that nephritics derive their energy from very much the same proportions of the various foodstuffs as do normal men.

The normal quotients found in patients with low carbon dioxid com-

binning capacity of the plasma prove that nephritic acidosis is not caused by difficulty in oxidizing carbohydrates.

Edematous nephritics kept on low diets show a reduction in food requirement similar to that usually found in prolonged undernutrition. Other nephritics have approximately the normal food requirement.⁴

CASE HISTORIES

CASE 1.—Joseph U., aged 19; chronic parenchymatous nephritis with acute exacerbation. Admitted March 27, 1916; died April 23, 1916.

History.—Five years prior to the test he had scarlet fever. Recently he has been a sign painter's helper but has not been much exposed to the danger of lead poisoning. His habits are good. For several years he has passed his water once or twice during the night. Early in March, 1916, after a wetting, he noticed edema of the eyelids, then edema of the ankles, disappearing at night. About March 20 the edema of the legs became permanent and a few days before admission the genitalia became edematous. He feels perfectly well.

Physical Examination.—Height 175 cm.; well nourished; color pasty; marked edema of face, back, genitalia, thighs and legs. Heart: Apex beat in the fifth space 11.5 cm. to the left of the median line. Left limit of dulness 12.5 cm. to the left; right limit, 3 cm. to the right of median line. Sounds are of good quality; no murmurs. Lungs are clear. There is marked acne of face and back.

The clinical data are given in Table 4 and a summary of the more important findings in Tables 2 and 3. His urine contained a large amount of albumin, pus casts and many granular casts; no glucose. The McLean indexes were as follows: March 31, 49; April 4, 46; April 10, 39. The CO₂ combining power of the plasma was as follows: April 4, 39 volume per cent.; April 5, 39 per cent.; April 8, 40 to 50 per cent.; April 9, 60 per cent.; April 10, 55 per cent.; April 16, 39 per cent.; April 19, 48 per cent.

Calorimeter observations were made on March 29, April 5 and April 10.

From March 29 to April 10 he was on a mixed diet containing about 1,500 calories, 5 gm. nitrogen and 1.5 gm. salt, with about 1,500 c.c. fluids in addition to the water of the so-called solid foods. He was given hot air baths almost every day, responding unusually well, losing between 480 and 900 gm. weight during the baths. His temperature was normal, he felt well and he lost 5 kg. weight in twelve days, the edema almost disappearing. During this period he passed 1,000 to 1,500 c.c. urine a day, containing from 10 to 13 gm. of nitrogen and 2 to 5 gm. of chlorids. The prognosis would have been favorable were it not for the low phthalein output on two occasions, the low McLean index, the high nonprotein nitrogen and high urea of the blood and the low carbon dioxid combining power of the plasma. The high phthalein output of April 4 stood in contrast to the other tests.

In order to eliminate the factor of acidosis he was given 40 gm. sodium bicarbonate between 6 p. m., April 8 and 6 p. m., April 9, the two days before the last calorimeter test.

On April 11 the picture changed markedly. He became very weak in the hot air bath and was removed at once. The temperature rose to 105 F. and remained elevated for five days. During this period his pulse was 98 to 124; respiration, 24 to 40. The edema increased. On the day after the onset,

4. The above work is a continuation of studies in cardiac and renal disease carried on a year previously in association with Dr. Francis W. Peabody of Boston. It is a pleasure to record the active participation of Dr. Peabody in about half of the experiments of this present series.

TABLE 1.—NEPHRITIS. DATA OF—

Subject, Date, Weight, Surface Area, Linear Formula	Period	End of Period	Carbon Dioxid, Gm.	Oxygen, Gm.	R. Q.	Water, Gm.	Urine N per Hour, Gm.	Indirect Calo- rimetry, Cal.	Heat Elimi- nated, Cal.
Case 1 (Joseph U.) 3/25/16 75.7 Kg. 1.84 Sq. M.	Prelim.	11:48	.....	.....	.....	.....	.....	.....	.....
	1	12:48	26.6	25.2	0.77	34.6	0.555	82.9	88.0
	2	1:58	26.8	25.1	0.78	35.5	0.555	82.9	86.9
	Aver.	.....	.....	.....	.....	.....	.....	.....	.....
Joseph U. 4/5/16 70.8 Kg. 1.83 Sq. M.	Prelim.	.....	.....	.....	.....	.....	.....	.....	.....
	1	11:58	22.6	22.6	0.73	28.8	0.375	73.9	77.2
	2	12:58	23.3	19.5	0.87	28.5	0.375	65.9	77.5
	3	1:58	22.7	18.3	0.90	28.5	0.375	62.5	78.0
	Aver.	.....	.....	.....	.....	.....	.....	.....	.....
Joseph U. 4/10/16 70.6 Kg. 1.83 Sq. M.	Prelim.	.....	.....	.....	.....	.....	.....	.....	.....
	1	12:27	23.6	21.2	0.81	22.5	0.408	70.7	74.2
	2	1:27	22.0	20.7	0.77	21.6	0.408	68.4	70.6
	Aver.	.....	.....	.....	.....	.....	.....	.....	.....
Case 2 (Lee H.).... 12/4/15 55.1 Kg. 1.57 Sq. M.	Prelim.	11:00	.....	.....	.....	.....	.....	.....	.....
	1	11:57½	17.4	15.1	0.84	21.9	0.249	50.7	54.6
	2	1:00	19.7	17.1	0.84	26.0	0.249	57.7	61.7
	Aver.	.....	.....	.....	.....	.....	.....	.....	.....
Lee H. 1/5/16 61.6 Kg. 1.70 Sq. M.	Prelim.	.....	.....	.....	.....	.....	.....	.....	.....
	1	12:40	16.0	13.7	0.85	20.3	0.296	46.1	51.1
	2	1:41	17.5	16.1	0.79	22.5	0.296	53.4	57.2
	Aver.	.....	.....	.....	.....	.....	.....	.....	.....
Case 3 (Edna S.)... 12/1/15 48.2 Kg. 1.39 Sq. M.	Prelim.	.....	.....	.....	.....	.....	.....	.....	.....
	1	12:39	14.2	11.0	0.94	18.0	0.713	38.1	40.0
	2	1:39	14.6	11.9	0.89	17.7	0.713	40.7	40.9
	3	2:09	7.2	5.4	0.96	8.6	0.713	18.9	20.7
	Aver.	.....	.....	.....	.....	.....	.....	.....	.....
Case 4 (Adam P.) 1/14/16 60.5 Kg. 1.60 Sq. M.	Prelim.	.....	.....	.....	.....	.....	.....	.....	.....
	1	12:25	19.1	17.0	0.82	22.1	0.340	56.6	61.2
	2	1:25	19.0	17.6	0.79	21.6	0.340	58.8	62.8
	Aver.	.....	.....	.....	.....	.....	.....	.....	.....
Adam P. 2/7/16 52.5 Kg. 1.52 Sq. M.	Prelim.	.....	.....	.....	.....	.....	.....	.....	.....
	1	12:30	17.5	16.4	0.78	21.9	0.163	54.5	55.7
	2	1:30	17.1	14.8	0.84	21.3	0.163	50.0	54.1
	Aver.	.....	.....	.....	.....	.....	.....	.....	.....
Case 10. (Isidore R.) 1/24/16 63.2 Kg. 1.87 Sq. M.	Prelim.	11:58	.....	.....	.....	.....	.....	.....	.....
	1	12:28	13.0	11.9	0.79	17.9	.....	39.6	43.3
	2	12:58	13.8	13.8	0.73	19.5	.....	45.2	45.0
	3	1:28	11.8	9.5	0.90	15.6	.....	32.7	34.1
	Aver.	.....	.....	.....	.....	.....	.....	.....	.....

—CALORIMETER EXPERIMENTS

Direct Calorimetry, Cal.	Rectal Temp., C.	Average Pulse	Work-Adder, Cm.	Non-protein R. Q.	Per Cent. Calories from			Calories per Hour		Remarks
					Protein	Fat	Carbo-hyd.	Per Kg.	Per Sq. M. (Lin.)	
.....	37.1	....	.....	.....	..	..	..	....	....	Basal; in bed
84.4	37.1	66	19.0	0.76	..	..	..	....	....	Quiet; reading 15 minutes
81.2	37.0	66	19.0	0.77	..	..	..	....	....	Quiet; not reading
.....	.....	....	.....	.....	18	66	16	1.10	45.1	
.....	36.9	....	.....	.....	..	..	..	....	....	Basal; in bed
66.2	36.7	55	16.0	0.72	..	..	..	....	....	Quiet
79.6	36.7	55	5.0	0.88	..	..	..	....	....	Very quiet
73.6	36.7	55	15.5	0.92	..	..	..	....	....	Very quiet
.....	.....	....	.....	.....	15	66	19	0.95	36.9	
.....	36.9	....	.....	.....	..	..	..	....	....	Basal; in bed
74.0	36.9	63	12.0	0.81	..	..	..	....	....	Quiet; asleep 15 minutes
85.0	37.2	64	4.0	0.77	..	..	..	....	....	Motionless
.....	.....	....	.....	.....	16	61	23	0.99	38.0	
.....	36.6	48	.....	.....	..	..	..	....	....	Basal; in chair
48.4	36.5	44	15.0	0.84	..	..	..	....	....	Fairly quiet; dozed
54.1	36.4	44	15.0	0.84	..	..	..	....	....	Fairly quiet
.....	.....	....	.....	.....	12	44	44	0.98	34.5	(1st period—57½ min. 2d period—62½ min. Basal; in bed
.....	36.8	61	.....	.....	..	..	..	....	....	Very quiet
54.9	36.9	67	10.0	0.86	17	41	42	....	....	Very quiet, until end of period; 61 minute period
52.4	36.8	68	14.0	0.79	15	62	23	....	....
.....	.....	....	.....	.....	..	..	..	0.80	29.0	
.....	37.0	....	.....	.....	..	..	..	....	....	Basal; in chair
37.3	37.0	82	1.0	0.94	..	..	..	....	....	Very quiet; reading
40.7	37.0	83	2.4	0.90	..	..	..	....	....	Very quiet
21.8	37.0	80	1.5	0.97	..	..	..	....	....	Very quiet; reading; 30 minute period
.....	.....	....	.....	.....	5	21	74	0.81	28	
.....	37.2	....	.....	.....	..	..	..	....	....
55.9	37.1	58	6.0	0.82	16	52	32	....	....	Very quiet
58.0	37.0	59	25.0	0.78	16	63	21	....	....	Somewhat restless
.....	.....	....	.....	.....	..	..	..	0.95	35.9	
.....	36.9	....	.....	.....	..	..	..	....	....	Basal; in bed
53.3	36.9	60	13.0	0.77	8	71	21	....	....	Very quiet
49.6	36.8	53	15.0	0.84	9	50	41	....	....	Quiet
.....	.....	....	.....	.....	..	..	..	1.00	34.4	
.....	37.1	....	.....	.....	..	..	..	....	....	"Basal"; in bed; Irrational
41.0	37.0	92	23.0	.....	..	..	..	....	....	Fairly restless; 30 min. period
44.3	37.0	96	30.0	.....	..	..	..	....	....	Restless; 30 min. period
38.2	37.1	....	6.0	.....	..	..	..	....	....	Asleep; very quiet; 30 min. period
.....	.....	....	.....	.....	..	..	..	1.24	41.9*	

* Results closer to true basal figures are obtained by using average R. Q. and taking CO₂ figures for first and third periods. This gives an average of 40.4 calories per square meter per hour.

TABLE 1.—NEPHRITIS. DATA OF—

Subject, Date, Weight, Surface Area, Linear Formula	Period	End of Period	Carbon Dioxid, Gm.	Oxygen, Gm.	R. Q.	Water, Gm.	Urine N per Hour, Gm.	Indirect Calo- rimetry, Cal.	Heat Elimi- nated, Cal.
Case 5 (Jack K.)... 3/4/16 58.8 Kg. 1.62 Sq. M.	Prelim.	11:58	.....	.....	.....	.....	.....	.....	.....
	1	12:58	24.7	20.1	0.89	23.3	0.525	68.2	69.0
	2	1:58	23.9	19.6	0.89	25.1	0.525	66.3	75.1
	Aver.	.....	.....	.....	.....	.....	.....	.....	.....
Case 6 (Frank C.) 2/28/16 Missing 1.54 Sq. M.	Prelim.	11:46	.....	.....	.....	.....	.....	.....	.....
	1	12:44	23.2	23.4	0.72	21.1	0.525	.....	67.4
	2	1:21	18.1	14.2	0.92	16.0	0.525	.....	47.8
	Total 95 min. Aver. per hr.	.....	.....	.....	.....	.....	.....	124.8	.....
Case 7 (John C.)... 2/9/16 69.8 Kg. 1.87 Sq. M.	Prelim.	.....	.....	.....	.....	.....	.....	.....	.....
	1	12:40	24.3	23.9	0.74	32.3	0.276	78.4	81.7
	2	1:40	25.0	22.1	0.82	30.9	0.276	74.3	79.9
	Aver.	.....	.....	.....	.....	.....	.....	.....	.....
Case 8..... (Mildred C.) 12/10/16 49.7 Kg. 1.40 Sq. M.	Prelim.	11:57	.....	.....	.....	.....	.....	.....	.....
	1	12:57	19.9	16.6	0.87	21.6	0.231	.....	49.7
	2	1:57	21.4	23.1	0.68	31.6	0.231	.....	61.9
	Aver.	.....	.....	.....	.....	.....	.....	65.8	.....
Case 9 (Wm. S.)... 12/6/16 64.2 Kg. 1.66 Sq. M.	Prelim.	11:40	.....	.....	.....	.....	.....	.....	.....
	1	12:40	22.2	20.9	0.77	26.1	0.483	68.8	68.3
	2	1:40	22.4	20.6	0.79	27.5	0.483	68.3	70.5
	Aver.	.....	.....	.....	.....	.....	.....	.....	.....

bronchial voice and breathing were heard over the right lower lobe. Two days later there was a small area of dulness and bronchial breathing at the angle of the left scapula. April 16 the temperature was normal and the patient felt weak but much better. By the 19th he was drowsy and his respirations slow and deep. There was persistent flatness and diminished breathing over the right lower lobe, but only 2 c.c. cloudy, sterile fluid could be withdrawn by needle. On the afternoon of the 22d he suddenly began to have violent convulsions, lasting until his death, shortly after midnight. No necropsy could be obtained.

After the febrile attack, which was probably pneumonia, the urine volume diminished rapidly, with a marked fall in the output of nitrogen and salt. This was in part due to a diarrhea.

CASE 2.—Lee H., aged 21, Chinaman, cook; chronic parenchymatous nephritis with acute exacerbation. Admitted Nov. 19, 1915, died Jan. 14, 1916.

History.—It was impossible to get any information as to the character of his previous illnesses. He says that he has always been well. He has been in New York five years. He says his present trouble began about Nov. 1, 1915.

Physical Examination.—Height 170 cm.; frame small, whole body, including face and scalp, markedly edematous. His color is pasty; he is orthopneic and dyspneic. Heart: Apex beat in the fifth space 10 cm. from median line; no murmurs. Lungs: At both bases, flatness, diminished breath sounds and

—CALORIMETER EXPERIMENTS—(Continued)

Direct Calorimetry, Cal.	Rectal Temp., C.	Average Pulse	Work-Adder, Cm.	Non-protein R. Q.	Per Cent. Calories from			Calories per Hour		Remarks
					Protein	Fat	Carbohyd.	Per Kg.	Per Sq. M. (Lin.)	
.....	36.9	72			..	..	..	....	....	Very quiet; basal
63.4	36.8	60	5.0	0.92	..	..	..	....	....	Asleep 35 min. Reading 10 min.
68.0	36.7	68	13.5	0.92	..	..	..	....	....	Very quiet; awake
.....	.....	.....	.....	.....	21	23	56	1.2	41.5	
.....	37.0	88	.....	.....	..	..	..	....	....	Basal (restless)
71.0	37.1	86	47.0	.....	..	..	..	....	....	58 min. period; very restless
50.6	37.2	89	54.0	.....	..	..	..	....	....	37 min. period; very restless
76.8	.....	.....	.....	0.80	18	57	25	1.6	51.2	Very unsatisfactory observation
.....	37.2	63								
74.9	37.1	57	19.0	0.74	..	..	..	....	....	Very quiet
75.5	37.1	60	18.5	0.83	..	..	..	....	....	Quiet
.....	.....	.....	.....	0.78	10	68	22	1.1	40.8	
.....	.....	104	.....	.....	..	..	..	....	....	Basal; in chair
.....	.....	103	5.0	0.88	..	..	..	....	....	Very quiet; slept
.....	.....	104	11.0	0.66						
.....	.....	.....	.....	0.77	9	73	18	1.32	47.0	Rectal thermometer out of order
.....	38.1	85								
74.9	38.3	86	6.0	0.76	..	..	..	....	....	Quiet
71.1	38.3	83	5.0	0.79	..	..	..	....	....	Quiet
.....	.....	.....	.....	.....	19	62	19	1.07	41.2	

fremitus. Radial arteries slightly thickened. Eyegrounds normal. Abdomen contains some fluid.

Patient was in the calorimeter December 4 and January 5. For clinical data December 4 and January 5 to 12, see Table 6, and also the summary, Tables 2 and 3.

The urine contained a large amount of albumin and many hyaline and granular casts. The specific gravity was high, usually in the neighborhood of 1.040. Glucose was absent. On some examinations red blood cells were found in the urine. The Wassermann test was faintly positive on three examinations. November 24 the blood urea was 32 mg.; creatinin, 0.84 mg.; chlorids, 0.51 mg.; freezing point, -0.647°C ; December 4, alveolar CO_2 38 mm. Hg; January 4, blood urea was 49 mg.; ammonia nitrogen, 1.1 mg.; chlorids, 0.612 per cent.; creatinin, 3.9 mg.; CO_2 combining capacity, 70 per cent. The phenolsulphonephthalein excretion in two hours was as follows: December 3, 64 per cent.; December 18, 44 per cent.; January 12, 13 per cent.

The blood pressure was not increased: Systolic, 115 to 120 mm.; diastolic, 75 to 85 mm.

The patient was kept on a moderately restricted diet and was given hot packs. His edema continued to increase but the dyspnea and orthopnea were not distressing and the patient remained cheerful. The physical signs of fluid in the pleural cavities and abdomen were practically unchanged.

January 4 he began to have fever in the afternoons, reaching 101 to 103 F., with morning remissions. He complained of pain in the abdomen and chest and began to cough. Over the lungs, anteriorly, there developed many moist, crackling râles, and over the precordium a cardiorespiratory friction rub. The urine volume fell to 600 to 900 c.c., with 11 to 17 gm. nitrogen and only a trace of chlorids. His bowels moved four to seven times a day. The patient grew more toxic and dyspneic but had no convulsions. He died, January 13. Postmortem aspiration of the pleural cavities and abdomen yielded milky fluid containing very few cells, but many diplococci. There was no necropsy.

The blood on January 7 showed hemoglobin, 75 per cent.; red blood cells, 4,500,000; leukocytes, 10,000; no filaria.

CASE 3.—Edna S., aged 13, schoolgirl, born in New York. Admitted Oct. 7, 1915; died May 2, 1916; chronic parenchymatous nephritis with acute exacerbation.

History.—Previous history negative except for measles and a mild sore throat. In 1912 she had a cough for a month and went to a physician who said she had kidney trouble. For the previous two years she had had frequent nosebleeds, but no frequency of micturition, headache, dizziness or edema until the present trouble. Sept. 1, 1915, her mother noticed edema of the face. October 4 she was put to bed by the family physician on account of edema of the legs. October 6 she lost her vision and had a convulsion of the right side of the body, and was also in a convulsion when she was brought to the hospital the next day.

Physical Examination.—Color pasty; face, body and extremities very edematous. The patient is a well nourished, intelligent girl, orthopneic and slightly dyspneic. Respirations, Cheyne-Stokes. Tonsils large, with deep crypts. Heart: Left border of dulness in the fifth space 2 cm. to the left of the mid-clavicular line; right border 2 cm. to the right of the midsternal line. The second sound in the aortic area is markedly accentuated; no murmurs. The liver edge is felt 2 cm. below the free margin of the ribs. The fundi of the eyes show slight haziness of the disk outlines. The blood pressure, which was 160 mm., dropped to 115 mm. after removal of 350 c.c. blood from vein.

On repeated examinations the urine showed large amounts of albumin, many hyaline and granular casts, and sometimes red blood cells. It was acid, contained no glucose, and the specific gravity averaged about 1.020.

The patient was given a restricted diet, with fruit and plenty of carbohydrate, but very little nitrogen and only small amounts of fluid. She was also given a daily hot pack. November 15 and again March 3 she had convulsions during which venesections were performed. In November and December there was little change in her general condition, the edema being extreme and the urine volume always scanty. The patient was in the calorimeter December 1.

January 28 fluid began to collect in the left pleural cavity. April 18 the temperature, which had been normal, rose to 101 F., then became very irregular, reaching 106 F., April 29. Cough and pain in the chest developed. She became more and more toxic and stuporous and died May 2, 1916. No necropsy could be obtained.

The phthalein tests were as follows: November 15, 16 per cent.; November 23, 61 per cent.

The blood tests: November 15: urea nitrogen, 14.5 mg.; November 18: urea nitrogen, 22.6 mg.; November 30: nonprotein nitrogen, 18.9 mg.; March 3: total nonprotein nitrogen, 19.7 mg.; urea nitrogen, 16.2 mg.; blood CO₂ combining power, 62 volume per cent.

The spinal fluid, March 3, removed when the patient was stuporous, ten minutes before the convulsions began, was under increased pressure.

CASE 4.—Adam P., aged 26, Russian, a tailor. Admitted Jan. 10, 1915; discharged improved, May 5, 1916; chronic parenchymatous nephritis with acute exacerbation.

History.—His father was a heavy drinker. At the age of 15 the patient had rheumatic fever for two months, involving many joints. Since then he has had some subacute symptoms. Six months prior to the test he had tonsillitis. He uses beer in moderation.

About April, 1915, he noticed edema of the legs, which has gradually increased and has involved abdomen, arms and face. Shortly afterward, he began to suffer from dimness of vision, dizziness and headaches. He has had increasing nocturia and now passes urine three to four times at night.

Physical Examination.—A well developed young man with marked generalized edema. He is not dyspneic. Heart: Left border of dullness 12.5 cm. from the median line. The second pulmonic sound is accentuated. At the bases of the lungs there is some dullness and diminution of breath sounds. Eyes: Fundi show chorioretinitis of long duration. He can distinguish fingers only at a distance of 2 feet. Dr. Rees believes that the eye condition has nothing to do with the nephritis.

The urine contained a large amount of albumin and many hyaline and granular casts. The specific gravity varied between 1.016 and 1.025. On admission the blood analysis was as follows:

Sugar	90	mg.
Urea nitrogen	34.3	mg.
Ammonia nitrogen	0.25	mg.
Creatinin	0.5	mg.
Uric acid	3.7	mg.
Plasma chlorids	0.60	per cent.

The phthalein test in two hours was 27 per cent. and the McLean index was 67.

The blood pressure was about 200 mm. systolic and 130 mm. diastolic until February 3; then it fell to about 160-105 mm.

The patient was given a restricted diet and, at first, hot packs. The generalized edema and hydrothorax continued. He was in the calorimeter January 14. At this time there were about 10 kg. of retained fluid in the edema. The daily urine volume was 1,000 to 1,500 c.c.; urine nitrogen, 8 to 11 gm.; chlorids, 5 to 8 gm. The patient lost weight steadily and when next in the calorimeter, February 7, had almost no edema. The McLean index February 8, was 25. The output of water, nitrogen and chlorids in the urine exceeded the intake. The calories in the diet were just about sufficient to cover the requirement. The volume per cent. of CO₂ in the plasma was as follows: January 13, 58; January 18, 62; February 8, 66.

The patient continued to improve slowly and by March 5 had no edema and no dyspnea and was able to get out of bed for a few hours. He was still unable to distinguish fingers at a greater distance than 4 feet. March 5, after walking a few steps, he complained of pain in the back. The next day the urine contained blood. For the following week he had pain over the right kidney, slight fever, many pus cells and a few red blood cells in the urine. The Roentgen ray revealed no calculus. Infarction of the kidney was suspected.

The pus in the urine disappeared in a few weeks. On March 17 the urine culture showed streptococci. He grew stronger and on May 5 was sent to a convalescent home. While on measured diets several experiments were made to determine the effect of sodium bicarbonate on his weight and the carbon dioxide combining capacity of his plasma.

CASE 9.—William S., aged 27, laborer, was admitted to the Fourth Medical Division, service of Dr. Nammack, Nov. 16, 1915; discharged improved Feb. 4, 1916; chronic parenchymatous nephritis.

History.—At the age of 9 he had scarlet fever, followed by impairment of the hearing. Two years prior to the test he had urethritis. During the previous year the legs and ankles were swollen at intervals and the face and genitalia were at times edematous. Recently, he has had headaches and pain in the back and lower thoracic region. He has had no dyspnea or cyanosis.

TABLE 2.—NEPHRITIS. SUMMARY—

Case Number and Name	Date in Cal'r.	Age, Yrs.	Diagnosis	Status	Temp., C.
1. Joseph U.	3/29	19	Chronic parenchymatous, Ac. Exac.	Died 4/23	37.1
	4/ 5	..	.....	.....	36.7
	4/10	..	.....	.....	37.0
2. Lee H.	12/ 4	21	Chronic parenchymatous, Ac. Exac.	Died 1/14	36.5
	1/ 5	..	.....	.....	36.8
3. Edna S.	12/ 1	13	Chronic parenchymatous, Ac. Exac.	Died 5/2	37.0
4. Adam P.	1/14	26	Chronic parenchymatous, Ac. Exac.	Improved	37.1
	2/ 7	..	.....	.....	36.8
9. William S.	12/ 6	27	Chronic parenchymatous	Improved	38.3
5. Jack K.	4/ 4	28	Chronic interstitial	Improved	36.8
10. Isidore R.	1/24	26	Chronic interstitial, uremia.....	Died 1/27	37.1
6. Frank C.	2/28	19	Chronic interstitial, uremia.....	Died 3/27	37.1
7. John C.	2/ 9	61	Chronic interstitial	Improved	37.1
8. Mildred C.	12/10	39	Chronic interstitial (hyperthyroidism?)	Improved	....

TABLE 3.—NEPHRITIS. SUMMARY—

Case Number and Name	Date in Cal'r.	Urine				Ambard McLean Index	Blood	
		24 Hr. Volume, C.c.	Total N, Gm.	Total Cl as NaCl	Phthalein per Cent. in 2 Hrs.		Nonprotein N, Mg.	Urea, Mg.
1. Joseph U. ...	3/29	1,520	12.1	4.1	10	48	—	59.5
	4/ 5	946	9.1	1.8	79	47	100.0	57.4
	4/10	985	9.3	2.3	16	39	117.0	53.2
2. Lee H.	12/ 4	570	7.2	—	64	..	.....	32.0
	1/ 5	260	7.8	0.9	13	..	.....	49.0
3. Edna S.	12/ 1	.....	....	...	..	..	.....	....
4. Adam P.	1/14	1,280	7.7	4.8	27	67	39.4	20.5
	2/ 7	1,340	6.7	4.1	31	..	41.0	18.9
9. William S.	12/ 6	1,230	10.7	—	48	..	41.7	17.3
5. Jack K.	3/ 4	1,750	6.8	6.9	8	82	72.5	53.9
10. Isidore R.	1/24	.....	....	...	..	..	165.0	58.1
6. Frank C.	2/28	.....	....	...	18	49	49.7	18.9
7. John C.*.....	2/ 9	975	8.1	5.8	35	..	33.3	16.1
8. Mildred C.	12/10	.....	....	...	20	134	26.2	13.2

1. On November 24.

2. Below 47, the normal for a girl of this age.

3. Very restless.

4. 62 years old.

—OF CLINICAL DATA

Pulse	Resp. Rate	Dyspnea	Orthopnea	Periodic Resp.	Cyanosis	Edema	Blood Pressure, Syst. Diast.	
66	±	—	—	—	++	175	108
55	—	—	—	—	+	144	84
64	±	—	—	—	+	150	94
46	15-18	+	+	—	—	+	110	80
67	+	+	—	—	++	115	85
82	±	++	—	—	+++	148	105
59	—	—	—	—	Mod.	230	140
57	—	—	—	—	—	185	120
85	20-25	±	±	..	—	++	178	90
65	—	—	—	—	—	197	145
94	++	—	++	±	—	155	100
88	+++	++	+	..	—	220	145
60	+++	++	++	+	—	230	125
104	+	+	..	—	—	260	170

—OF LABORATORY DATA

Creatinin, Mg.	Blood		CO ₂ Comb. Power, Volume per Cent.	Calories per Sq. M. per Hour	Variation from Average Normal Lin.	Calories per Kg.	R. Q.
	Total Chlorids, Mg.	CO ₂ Comb. Power, Mm. Hg.					
....	0.649	..	....	45.1	+14	1.10	0.77
1.91	0.665	26	38.8	36.9	— 7	0.95	0.83
....	0.634	38	55.0	38.0	— 4	0.99	0.79
0.84 ¹	0.51 ¹	47	....	34.5	—13	1.00	0.84
3.9	0.612	..	70.2	29.0	—27	0.80	0.82
....	.....	..	....	28.0	—40 ²	0.81	0.93
....	0.623	..	57.8	35.9	—10	0.95	0.80
....	0.672	..	66.3	34.4	—13	1.00	0.81
....	.....	31 ⁵	....	41.2	+ 4	1.07	0.78
2.6	0.740	35	52.8	41.5	+ 5	1.15	0.89
....	0.609	19 ⁶	43.6	40.4 ⁷	+ 2	....	0.82 ⁸
....	0.528	..	63.5	51.2 ³	+29	1.56	0.82
....	0.594	..	69.1	40.8	+10	1.09	0.78
....	0.694	..	....	47.0	+27	1.32	0.77

5. Alveolar air.

6. On January 21.

7. Calculated from CO₂ of first and third periods.

8. Somewhat restless throughout.

Physical Examination.—A somewhat undernourished young man with marked edema of the whole body, including face and genitalia. The heart is enlarged, the left border of dulness being 12.5 cm. to the left of the median line; the right border, 6 cm. to the right. At the bases of the lungs there is dulness and diminished resonance and breath sounds. There is some fluid in the abdomen.

The urine was acid; specific gravity 1.018 to 1.022; glucose absent; albumin present in large amounts, with many hyaline and granular casts and many red blood cells. Wassermann weakly positive.

December 3, a note says: "Patient lying flat in bed in no distress. Hands are blue; face neither cyanotic nor edematous. Heart sounds of good quality; no murmurs. Second sound is reduplicated; second aortic sound much accentuated. Lungs: Dulness at bases extends on both sides to within three finger-breadths of scapulae. There are a few coarse râles at the left base. Abdomen much distended and dull in right flank. No shifting dulness or fluid wave. There is marked edema of body wall from costal margin downward, and of legs and feet, and slight edema of thighs and genitalia." The phthalein test was 48 per cent. December 3. Blood pressure: 160 mm. systolic; 95 mm. diastolic. Patient was in the calorimeter December 6.

December 6, before he was put in the calorimeter, the temperature began to rise and continued irregular, reaching 103 F.; pulse 74 to 100; respirations 18 to 28. The patient developed a cough and the lungs showed many râles but no consolidation. December 8 the alveolar CO₂ was 31 mm. Hg. December 13 the febrile attack ended and patient improved steadily, but on February 4, when he was discharged, he still complained of swelling of the ankles and slight headache. The table of clinical data (Table 6), December 4 to 6, shows the urine volume 800 to 1,300 c.c., with 8 to 11 gm. nitrogen.

CASE 5.—Jack K., aged 28, baker. Admitted Feb. 15, 1916; discharged improved; chronic interstitial nephritis.

History.—At the age of 7 the patient had diphtheria. In 1901, while in the army, he had malaria. He has had frequent sore throats and in 1912 had rheumatic fever following tonsillitis. The same year he had urethritis. He was formerly a heavy drinker.

In August, 1914, he began to have pain in the head and lumbar region, epistaxis, vomiting, dizziness, edema of legs, weakness and frequency of urination. He was in the hospital for a long time, being discharged only two months before entrance into Bellevue. Feb. 12, 1916, he had nosebleed, occipital headache and dizziness. Things got black before his eyes. February 15, the day of admission, he noticed edema of the legs. He has been passing urine three to five times at night and has lost 8 pounds in one month. He has had no night sweats or cough.

Physical Examination.—A well developed and well nourished man of rather sullen demeanor. He is not dyspneic or cyanotic and there is only slight edema of the feet. Heart: Left border of dulness in the fifth space is 12.5 cm. from the median line; right border, 4 cm. to the right of median line. Radial arteries are hardened. Lungs are clear. Eyes: Fundi show slight haziness of disk outline and of vessels.

March 4 the patient was in the calorimeter. His condition was practically unchanged except that the edema had disappeared.

His urine was acid; specific gravity 1.010 to 1.012 on repeated examinations and in two-hour day and night specimens. Glucose was absent. Albumin was present in a heavy cloud, with casts, a few leukocytes, but no red blood cells. The Wassermann test on the blood was negative.

The blood pressure was, systolic, between 214 and 197; diastolic, between 96 and 145.

Phthalein Tests: February 19, 13 per cent.; March 3, 8 per cent.

Blood: February 23, nonprotein nitrogen 90.7 mg. March 3, nonprotein nitrogen 72.5 mg.; urea nitrogen, 53.9 mg.; creatinin, 2.6 mg.; chlorids, 0.740 per cent.; McLean index, 82. March 2, CO₂ combining capacity of plasma, 53 Vols. per cent.

CASE 10.—Isidore R., aged 26, pedler, Austrian Hebrew. Admitted Jan. 15, 1916; died Jan. 27, 1916; chronic interstitial nephritis; uremia.

History.—At the age of 9 years the patient had pneumonia; at 22 years, urethritis. In April, 1915, following exposure, he noticed swelling of ankles and face. Two months later the abdomen became swollen and he had anorexia and gastric distress. He went to the Michael Reese Hospital in Chicago, where he was told his blood pressure was 160 mm. He was treated with hot air baths, the ascites disappeared, and he was discharged in three months. Three weeks later the symptoms returned and he entered Mount Sinai Hospital, New York, where he was told his blood pressure was 200 to 210 mm. He left early in December and on December 21 entered Bellevue. Here his phthalein excretion, December 29, was 10 per cent. in two hours. He was transferred to the Metropolitan Hospital, but left after a few days. Previous to his second admission to Bellevue, Jan. 15, 1916, he suffered from dyspnea, edema, headache, oliguria, nausea and vomiting. The cause of his frequent changes of hospital was evidently his restless, insubordinate disposition.

Physical Examination.—January 20: A well nourished man in great distress; very pale; lying on two pillows, gasping for air, with marked sighing, deep respirations every five or six breaths. His mucous membranes were pale, his tongue coated, his pupils large and reacting sluggishly to light. Heart: Left border of dullness in the fifth space 1 cm. outside the nipple line; right border, 3 cm. from median line. The sounds are very short and snapping, with a true gallop rhythm. The lungs are clear. The abdomen is tense and tympanitic, with no dullness and no tenderness. There is no edema. The fundi show an albuminuric retinitis.

The urine, January 17, was acid; specific gravity 1.018; no glucose; albumin present in large amount; no casts seen and no red blood cells. January 19 the CO₂ combining capacity of the plasma was, in terms of alveolar CO₂, only 17 mm. Hg; January 21, only 19 mm. Since he refused all medication by mouth, he was given intravenously 400 c.c. of a 5 per cent. solution of sodium bicarbonate at 8 p. m., January 21. Half an hour later he had a chill and the pulse became very rapid. Next day the respirations, which had been rapid, shallow and periodic, became normal. The CO₂ capacity rose to 37 mm. Hg. He was brighter mentally, though still apathetic. A marked diarrhea developed. On the 23d, a pericardial rub was heard and the patient became more stuporous. He was in the calorimeter January 24. On the 27th he died. No necropsy could be obtained.

January 15 to 19 the temperature was 99 to 101; pulse 88 to 96; respirations 20 to 24; stools, one a day. January 20 to 27 the temperature was 100 to 101; pulse 92 to 110; respirations 12 to 36; stools, five to ten a day. The blood examinations were as follows:

January 20, nonprotein nitrogen, 103 mg.; chlorids 0.609 per cent. January 22, nonprotein nitrogen, 101 mg.; chlorids, 0.572 per cent. January 24, nonprotein nitrogen, 165 mg.; urea nitrogen, 68 mg.; chlorids, 0.609 per cent.

The CO₂ combining capacity of the blood plasma in volumes per cent. was as follows: January 19, 25; January 20, 29; January 21, 28; January 22, 55; (after bicarbonate) January 23, 53; January 24, 44; January 26, 51; January 27, 44.

The systolic and diastolic blood pressures were:

	Systolic, Mm.	Diastolic, Mm.
January 18.....	210	110
January 21.....	183	110
January 22.....	153	88
January 23.....	158	116
January 24.....	155	100

The patient took very small amounts of food and was incontinent so much of the time that it was impossible to collect twenty-four-hour specimens of urine.

TABLE 4.—NEPHRITIS—

Case Number Name and Date	Temperature		Food			Food N., Gm.	Urine N., Gm.	Excreta N., ¹ Gm.
	Max.	Min.	Total Calories	Carbohy- drate, Gm.	Fat, Gm.			
Case 1 Joseph U. 3/29/16	99.4	97.8	1,081	145	42	3.9	12.1	12.5
3/30/16	99.0	97.4	1,287	176	49	4.4	11.1	11.6
3/31/16	98.8	97.8	1,551	225	54	4.9	13.2	13.7
4/ 1/16	Normal		1,554	215	59	5.0	11.3	11.8
4/ 2/16	Normal		1,553	213	59	5.2	11.4	11.9
4/ 3/16	Normal		1,579	216	61	5.1	9.6	11.1
4/ 4/16	Normal		1,455	207	52	4.8	9.7	10.1
4/ 5/16	Normal		1,200	164	53	5.4	9.1	9.6
4/ 6/16	Normal		1,712	226	64	7.4	9.8	10.5
4/ 7/16	Normal		1,474	207	54	4.9	9.5	10.0
4/ 8/16	98.6	97.0	1,673	228	56	5.0	9.2	9.7
4/ 9/16	Normal		1,433	197	55	5.0	9.3	9.8
4/10/16	Normal		1,375	186	51	5.2	9.3	9.9
4/11/16	105.0	99.4	1,252	182	42	4.4	11.2	11.6
4/12/16	104.8	100.4	0 ²	0	0	0	7.8 ³	7.8
4/13/16	102.8	99.6	609	31	45	2.6	4.7 ⁴	5.0
4/14/16	103.8	100.6	0 ²	0	0	0	2.4 ⁵	2.4
4/15/16	101.4	98.8	672	61	38	2.8	1.1	2.4
4/16/16	Normal		916	116	40	2.7	2.0	2.3
4/17/16	Normal		830	88	42	3.3	2.6	2.9
4/18/16	Normal		930	88	49	4.3	2.8	3.2
4/19/16	Normal		908	117	38	2.9	3.2	3.5
4/20/16	Normal		692	132	13	1.2	6.5	6.6
4/21/16	Normal		916	149	27	2.1	6.5	6.7
Case 6 Frank O. 2/27/16	Normal		980	124	43	3.2	15.6	15.9
2/28/16	Normal		664	60	39	2.1	11.9	12.2
3/24/16	Normal		1,687	250	60	4.2	17.5	17.9
3/25/16	Normal		792	108	32	1.8	15.7	15.9

1. Excreta nitrogen calculated as urine nitrogen plus 10 per cent. of food nitrogen.

2. Vomited.

4. 21 hours 40 minutes.

3. 26 hours 20 minutes.

5. 24 hours 10 minutes.

—CLINICAL DATA

Nitrogen Balance, Gm.	Body Weight, Kg.	Urine Volume, C.c.	Calories per Kg.	Fluid Intake, C.c.	NaCl Intake, Gm.	Urine NaCl, Gm.	Blood Pressure, Syst. Diast.
—8.6	75.7	1,520	14	1,020	1.34	4.08	175 108
—7.1	74.7	1,470	16	1,235	1.10	4.78	165 113
—8.8	73.5	1,682	21	1,470	1.44	4.91	168 110
—6.8	72.9	1,340	21	1,470	1.27	3.84	
—6.7	72.1	1,230	21	1,420	1.39	3.36	
—6.1	71.2	1,090	22	2,050	1.34	3.17	
—5.4	71.4	1,030	20	1,970	1.69	2.19	
—4.3	70.8	946	17	1,380	2.09	1.84	144 84
—8.1	71.4	1,056	24	1,680	2.09	2.03	
—5.0	71.8	995	20	1,400	1.31	1.66	
—4.7	70.8	1,000	23	1,725	1.77	1.66	
—4.8	71.3	1,040	20	2,020	1.74	1.84	
—4.6	70.6	935	19	2,150	1.97	2.30	
—7.2	72.1	1,050	17	2,875	1.38	1.18	150 94
—7.8	....	750 ⁸	0	1,360	0	0.52	
—2.4	71.2	480 ⁴	8	1,380	0.88	0.52	134 90
—2.4	....	250 ⁶	0	2,275	0	0.09	
+0.4	....	160	9	1,000	0.85	0.22	
+0.4	....	290	13	820	0.92	0.40	150 90
+0.4	71.0	350	11	1,005	1.02	0.40	
+1.1	71.0	360	12	1,515	1.54	0.26	
+0.5	70.9	420	12	1,200	1.05	0.31	
—5.4	71.1	400	9	760	0.52	0.45	
—4.6	70.9	380	12	950	0.77	0.36	
—12.7	51.0	2,340	19	2,010	....	4.03	220 145
—10.0	50.2	2,292	13	2,360	0.70	1.86	
—13.7	49.4	4,260	34	1,090	1.18	7.72	
—14.1	48.7	2,930	16	3,270	0.43	4.82	

TABLE 5.—NEPHRITIS.—

Case Number, Name and Date	Food			Food N., Gm.	Urine N., Gm.	Excreta N., ¹ Gm.	Nitrogen Balance, Gm.
	Total Calories	Carbohy- drate, Gm.	Fat, Gm.				
Case 4 Adam P. ²	.....	...	..	...	....	....	....
1/13/16	1,603	183	79	4.6	11.0	11.5	-6.9
1/14/16	1,606	148	95	4.6	7.7	8.2	-3.6
1/15/16	1,627	203	72	5.0	9.3	9.8	-4.8
1/16/16	1,609	203	72	4.4	8.1	8.5	-4.1
1/22/16	1,174	154	47	4.1	7.6	8.0	-4.0
1/23/16	1,464	204	58	5.2	8.2	8.7	-3.5
1/24/16	1,345	175	58	5.1	7.2	7.7	-2.6
1/25/16	1,616	224	61	5.1	7.7	8.2	-3.1
1/26/16	1,595	205	66	5.5	7.9	8.4	-2.9
1/27/16	1,391	186	54	5.0	6.6	7.1	-1.1
1/28/16	1,486	214	51	5.3	6.9	7.4	-2.1
1/29/16	1,434	179	62	4.8	6.0	6.5	-1.7
1/30/16	1,577	226	57	4.6	7.0	7.5	-2.9
1/31/16	1,601	216	63	5.3	7.9	8.4	-3.2
2/ 1/16	1,423	204	52	4.2	6.4	6.8	-2.6
2/ 2/16	1,518	202	60	5.0	6.2	6.7	-2.7
2/ 3/16	1,634	225	63	4.9	6.7 ³	7.2	-2.3
2/ 4/16	1,488	211	54	4.8	6.5 ⁴	7.0	-2.2
2/ 5/16	1,569	225	56	4.9	5.6 ⁵	6.1	-1.2
2/ 6/16	1,477	194	60	4.9	6.7 ⁶	7.2	-2.3
2/ 7/16	1,321	181	48	5.2	6.7	7.2	-2.0
2/ 8/16	1,558	221	56	4.8	6.6	7.0	-2.2
2/ 9/16	1,529	212	57	4.8	6.5	7.0	-2.1
2/10/16	2,153	195	103	15.2	7.0	8.5	+6.7
2/11/16	2,138	192	105	14.6	10.4	11.9	+2.7
2/12/16	2,024	204	87	14.9	11.1 ⁷	12.6	+2.3
2/13/16	2,029	199	86	15.1	12.2 ⁸	13.7	+1.4
2/14/16	2,010	191	90	15.2	13.7	15.1	+0.1

1. Excreta nitrogen calculated as urine nitrogen plus 10 per cent. of food nitrogen.

2. Temperature normal.

3. 25 hours 15 minutes.

4. 22 hours 25 minutes.

5. 23 hours 25 minutes.

6. 24 hours 55 minutes.

7. 22 hours 20 minutes.

8. 25 hours 35 minutes.

—CLINICAL DATA

Body Weight, Kg.	Urine Volume, C.c.	Calories per Kg.	Fluid Intake, C.c.	NaCl Intake, Gm.	Urine NaCl, Gm.	Blood Pressure Syst. Diast.	
.....	.....	..	.....	....	....	230	140
61.4	1,590	26	.....	2.57	7.48	226	200
60.6	1,280	26	.....	1.20	4.78		
60.3	1,460	26	1,392	1.68	7.77		
58.3	1,040	27	1,518	0.64	5.39		
54.6	960	22	820	1.18	6.28		
54.6	1,460	27	1,220	1.22	13.34		
54.3	975	25	980	1.39	3.61		
53.7	940	30	810	1.99	3.76		
58.8	1,270	29	1,215	2.00	6.23		
53.7	900	26	820	1.24	3.83		
53.2	1,010	27	1,255	1.68	3.15		
53.6	930	26	1,050	1.71	2.02		
53.9	930	29	1,550	1.34	1.88		
54.8	1,140	29	1,314	2.12	2.30		
54.7	1,410	26	1,540	1.48	1.62	205	130
55.0	1,180	27	1,175	1.54			
55.1	960	29	1,085	2.01	1.91	195	120
54.8	1,340	27	970	1.36	3.17		
53.6	1,280	29	995	1.87	2.88		
53.3	1,360	27	800	1.38	5.65		
52.5	1,337	25	1,080	1.36	4.08	185	120
52.6	1,425	29	1,185	1.66	3.83		
52.4	1,200	29	925	1.40	4.79		
51.6	840	41	1,000	3.39	4.70		
51.7	1,000	41	1,290	3.23	3.64	193	128
51.6	1,000	39	1,040	2.96	5.55		
51.5	1,040	39	1,060	2.90	4.61		
51.7	1,120	38	1,160	2.80	4.98		

TABLE 6.—NEPHRITIS.—

Case Number Name and Date	Temperature		Food			Food N., Gm.	Urine N., Gm.	Excreta N., ¹ Gm.
	Max.	Min.	Total Calories	Carbohy- drate, Gm.	Fat, Gm.			
Case 2 Lee H. 12/ 4/15	98.0	97.6	1,153	116	56	6.3	7.2	7.8
1/ 5/16	100.6	98.6	1,146	136	51	4.6	7.8	8.3
1/ 6/16	101.8	98.2	447	32	27	3.2	6.8 ²	7.1
1/ 7/16	102.0	98.6	296	14	20	2.5	16.8 ³	17.1
1/ 8/16	103.4	99.8	477	45	20	4.0	16.3	16.7
1/ 9/16	103.0	99.6	544	49	27	3.8	14.6	15.0
1/10/16	102.6	100.6	664	68	31	4.0	14.1	14.5
1/11/16	102.4	100.6	142	12	8	0.7	11.3	12.0
1/12/16	102.0	98.6	412	46	18	2.3	11.1	11.3
Case 9 William S. 12/4/15	....	....	1,268	140	55	7.2	9.6	10.3
12/5/15	99.2	97.0	1,180	141	43	8.0	7.6	8.4
12/6/15	103.0	99.8	1,470	144	69	9.4	11.1 ⁴	12.0
Case 7 John C. 2/ 8/16	Normal							
2/ 9/16	Normal		1,415	189	57	4.4	8.1	8.5
2/10/16	Normal		2,009	285	76	5.3	6.1	6.6
2/11/16	Normal		1,959	269	78	5.2	5.9	6.4
Case 5 Jack K. 9/4/16	.....		1,569	204	66	4.7	6.8	7.3

1. Excreta nitrogen calculated as urine nitrogen plus 10 per cent. of food nitrogen.

2. 23 hours.

3. 25 hours.

4. 23 hours 25 minutes.

CASE 6.—Frank C., aged 19, born in Italy. Admitted Feb. 23, 1916; died March 27, 1916; chronic interstitial nephritis; uremia.

History.—No cause of nephritis was found. He says he has always been well and has been a very moderate user of alcohol. For many years he has had nocturia; for two and a half months dimness of vision; for two days, severe frontal headache and scanty urine; for one day, nausea and vomiting. He has had no edema.

Physical Examination.—Patient is well developed and well nourished. He is dyspneic, orthopneic, pale; his eyes have a vacant stare, and he is evidently in pain. Breath urinous. He has no edema. Heart: Left border of dulness in the fifth space 1 cm. outside the nipple line; right border at the sternal margin; no murmurs; second aortic sound markedly accentuated. Arteries not markedly sclerosed. Fundi show marked albuminuric retinitis with hemorrhages. He cannot count fingers at 2 feet.

The urine contained a large amount of albumin, many hyaline and granular casts and a few red blood cells. The Wassermann reaction was very faintly positive.

February 24 he had a spastic convulsion lasting forty-five minutes.

—CLINICAL DATA

Nitrogen Balance, Gm.	Body Weight, Kg.	Urine Volume, C.c.	Calories per Kg.	Fluid Intake, C.c.	NaCl Intake, Gm.	Urine NaCl, Gm.	Blood Pressure, Syst. Diast.
-1.5	55.1	570	21	.....	4.30	....	110 80
-3.7	....	260	..	1,278	2.20	0.85	115 85
-3.4	61.5	240	7	960	0.23	Trace	
-14.6	....	600	..	1,160	0.97	Trace	
-12.7	60.7	940	8	1,140	0.56	Trace	
-12.0	60.2	940+	9	745	0.92	Trace	
-10.5	59.1	900+	11	880	1.56	Trace	
-11.3	59.1	640+	2	885	0.39	Trace	
-9.0	55.9	616	7	720	0.65	Trace	
-3.1	....	1,360	..	.....	4.24		
-0.4	64.1	780	18	.....	7.72	....	155 120
-2.6	64.2	1,278	21	.....	4.40	....	178 90
-4.1	70.0	975	22	955	1.55	5.75	230 125
-1.3	70.1	480	29	850	2.10	1.92	
-0.5	69.3	420	28	975	1.89	2.06	236 130
-8.6	58.5	1,750	26	870	3.23	6.92	197 145

The patient was in the calorimeter February 28. He was irrational and very restless, sitting up in the bed at frequent intervals. His condition had not changed much since admission and he still had headache, but he was passing urine freely, 2,300 to 4,300 c.c. per diem, containing 12 to 17 gm. nitrogen and 2 to 8 gm. sodium chlorid. His breath was not so urinous. The blood pressure was 250 mm. systolic; 130 mm. diastolic.

For a time he improved. March 15 his hemoglobin was 56 per cent.; red blood cells, 3,350,000. March 22 the nonprotein nitrogen of the blood was 46 mg.; creatinin, 1 mg. In the spinal fluid the nonprotein nitrogen was 32 mg.; urea, 17 mg. Blood pressure: 220 mm. systolic; 178 mm. diastolic.

March 21 he began to have headache and nausea once more. March 22 he had a convulsion. After this he became blind, grew more toxic, with marked headaches, and on March 27 died. No necropsy was obtained.

February 28 the urine was collected as follows:

Time of Voiding	Volume, C.c.	Specific Gravity
9:00 a. m.....	410	1.010
2:30 p. m.....	425	1.015
5:20 p. m.....	400	1.010
9:10 p. m.....	300	1.010
4:00 a. m.....	600	1.012
6:30 a. m.....	280	1.010

February 28, McLean index 79. CO₂ combining capacity of the plasma in volume per cent., February 24, 66; February 28, 64.

CASE 7.—John C., aged 61, watchman. Admitted Feb. 8, 1916; transferred to City Hospital Feb. 18, 1916, improved; chronic interstitial nephritis.

History.—Thirty-five years prior to test he had urethritis and probably lues. Six years prior he had rheumatic pains in the left shoulder. He has been an excessive pipe smoker but a moderate user of alcohol. In spite of his 61 years he still had the sexual vigor of a young man.

Two years prior to test his joints ached and he was told that his blood pressure was 288 mm. For the five months previous to examination he had been unable to work on account of failing eyesight. He has been dyspneic on climbing two flights of stairs. At times he has severe frontal headaches, dizziness and occasionally loses control of his tongue and becomes aphasic. He has marked frequency of urination, six to eight times in the day, four or more times at night.

Physical Examination.—Well nourished; looks younger than his age. His respirations are deep and regular. He is orthopneic but not cyanotic or edematous. The teeth are in very bad condition. Heart: Apex beat in the sixth space 15 cm. from the median line; second aortic sound much accentuated. There is a large, deep scar on the penis.

Urine: February 8 the phthalein output was 25 per cent. in two hours. February 9 to 12 the daily urine volume was 400 to 1,000 c.c.; nitrogen, 6 to 8 gm.; sodium chlorid 2 to 6 gm. His temperature was normal; pulse 60 to 88; respiration 14 to 22. The blood pressure on two examinations was 285 and 236 mm. systolic; 165 and 130 mm. diastolic. February 8 the McLean index was 136 and the CO₂ combining power of the plasma was 69 volumes per cent.

CASE 8.—Mildred C., aged 39, milliner, born in England, single. Admitted Nov. 23, 1915; discharged improved, Jan. 6, 1916. Chronic interstitial nephritis; uremia; hyperthyroidism (?).

History.—Three years prior to admission she had diphtheria. In August, 1915, while on a street car, she began to suffer from headache and vomiting and was brought to Bellevue, where she remained unconscious for four days, and was discharged two weeks later. At this time the urine contained much albumin and many hyaline and granular casts. The Wassermann reaction was strongly positive.

As long as she can remember she has had severe headaches, with nausea and vomiting. These come about every month but are not related to the menses, which are normal. Her appetite is fair, bowels constipated. For one year she has had marked nocturia.

Following her first stay in Bellevue she went back to work. For a week she has had a severe headache. She has had no dyspnea and no edema.

Physical Examination.—November 23: A thin, nervous woman who looks chronically ill. She is slightly dyspneic and orthopneic. There is moderate exophthalmos but no von Graefe's sign, no goiter, no tremor and only slight tachycardia. Heart: Left border of cardiac dulness is 12.5 cm. from the midsternal line; right border, at right sternal margin; the second aortic sound is accentuated; in the aortic region there is a thrill and a systolic murmur. The lungs are normal. The liver edge, spleen and right kidney are palpable. The knee jerks are exaggerated. Ophthalmoscopic examination, negative.

The urine was acid; specific gravity 1.010 to 1.018; glucose absent; albumin present in large amount; a few granular casts were found but no red blood cells. The blood count showed:

Red blood cells.....	5,080,000
Leukocytes	7,200
Differential, normal	

The patient was put on a somewhat restricted diet and given chloral, 5 grains, and potassium iodid, 5 grains, every day except December 10, when she was in the calorimeter. She improved steadily and was able to go back to work January 6.

The temperature was normal; pulse, 85 to 100; respiration, 20 to 22. The systolic and diastolic blood pressures were as follows:

	Systolic, Mm.	Diastolic, Mm.
November 23.....	265	190
December 9.....	260	170
January 5.....	250	150

Phthalein test, December 1, first hour, 10 per cent.

November 30 the blood analysis was as follows:

Sugar	105.0	mg.
Chlorids	0.54	per cent.
Urea nitrogen	25.0	mg.
Ammonia nitrogen	3.2	mg.
Uric acid	2.6	mg.
Creatinin	2.0	mg.
Corpuscular volume	36.0	per cent.

December 10 the McLean index was 134.

Feb. 13, 1916, the patient was admitted to Bellevue once more. She had a severe headache the day before admission, followed by a general convulsion. The blood pressure was 240 mm. systolic; 128 mm. diastolic. A few days later she left the hospital in fair condition.

477 First Avenue.