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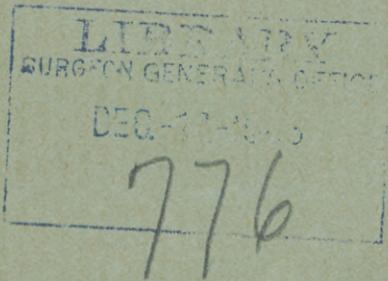
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OBSERVATIONS ON THE QUANTITY OF DAY AND NIGHT URINE.*

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Ever since physiology and pathology have occupied a place in the scientific world, the kidney and the various problems connected with the excretion of urine have taken a place scarcely second to any in medicine, and the literature of the subject is enormous. We need merely suggest such purely fundamental questions as how the urine is excreted; how the activity of the organ can be altered or the composition of the urine changed by various factors in health or disease, to indicate the wide extent of the field and how much yet remains that is unsettled, which will furnish material for study and research in the future.

There is one phase of the question of clinical, as well as of scientific, interest, which does not seem to receive so much attention as it merits. This is the relative proportion of urine excreted during the day and the night in health and in certain pathological conditions.

Several have studied the relation, as it exists in health, with fairly uniform results. The figures of H. Roger, cited by Certowitch¹ will be given as being an average. He divided the twenty-four hours into two unequal parts—sixteen hours day, and eight hours night, making his observations, which covered a period of thirty-two days, upon an individual aged thirty-four years; during which time, while the food was varied, the liquid taken was carefully measured, as was also the urine, with the average results here given:

| | 24 hours. | Day. | Night. |
|-----------------------|------------|------------|-----------|
| Total | 1497 c. c. | 1152 c. c. | 345 c. c. |
| Average per hour..... | 62 c. c. | 72 c. c. | 43 c. c. |

The quantity of day urine (Qd) as compared with the night (Qn) would thus be Qd:Qn::62:38 (or as 100:61).

The earlier observers expressed the ratio by taking the day urine as 100 and the night in relation to it; but I prefer to consider the total urine as 100, and then express the day and night urines as parts of it, and this method has been followed in the tables given later. Quincke² and Lapeyres³ divided the twenty-four hours into pe-

riods of fifteen hours and nine hours—from 6 a. m. to 9 p. m. for day urine, and 9 p. m. to 6 a. m. for that of the night. They consider a normal ratio Qd:Qn::100:50, but say that 100:90 may occur, and still be within physiological limits, but that in the twenty-four hours thus divided Qn should never be equal to or greater than Qd.

In the following observations the periods are 7 a. m. to 7 p. m. and 7 p. m. to 7 a. m., thus making them of equal length. It was necessary, therefore, to obtain a new standard for the normal, with which to compare the diseased conditions. For this purpose, observations were made for a month during the fall of the year upon a young adult in active life, making no change in his habits of eating and drinking, but the urine passed was measured and the bladder always emptied at 7 o'clock, morning and evening. In the ratio thus obtained the Qd was to the Qn as 67:33 (or as 100:50). This result, as will be seen, agrees very well with those previously mentioned when the difference in the daily division is taken into consideration, but I think we must allow, with the twelve-hour periods, that a ratio of 50:50 (to correspond with the 100:90 ratio mentioned) may be within physiological limits although probably it is rather exceptional.

Having settled upon a normal proportion, let us now consider the conditions as modified by disease, taking first a brief glance at the results obtained from cases previously reported.

Quincke⁴ was the first to call attention to the fact that, in cases of œdema, more urine was passed during the night than the day. Wilson⁵ reported seven cases of kidney and cardiac disease, in which the ratio Qd to Qn was disturbed and said that this change should be an aid to diagnosis in suspected renal disease.

Iljisch⁶ reported twenty-nine cases of œdema and arrived at the same conclusions as to the disturbed relation in cases with œdema, and also in nephritis without œdema. He adds that (1) in cardiac disease in periods of compensation the relation is normal; (2) as œdema is being lessened the Qn is usually markedly increased, and finally,

* Made in the Medical Clinic, University Hospital, Ann Arbor, Mich. Read before Section in Internal Medicine and Pathology, Wayne County Medical Society, Detroit, Mich., October 12, 1903.

¹ *Les quantités des urines diurnes et nocturnes à l'état normal et pathologique.* Thèse Inaugurale, Genève, 1901.

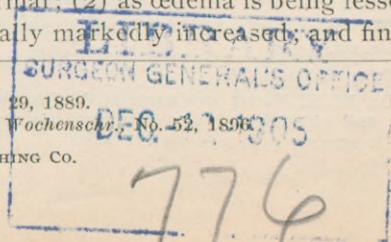
² *Arch. f. exp. Path. u. Pharm.* Band 32.

³ *Deut. Arch. f. klin. Med.* Vol. lxxviii. 1900.

⁴ *Loc. cit.*

⁵ *Lancet*, June 29, 1889.

⁶ *Munch. med. Wochenschr.* No. 52, 1896.



(3) if such patients are out of bed several hours during the day the Qn is markedly increased.

Laspeyres⁷ gave the literature of the subject and reported sixty-five cases. Among his conclusions he states that: the greatest nightly polyuria occurs in cases of myocarditis; nervous tachycardia does not give nightly polyuria, and it will serve to aid the diagnosis between organic and non-organic diseases of the heart; acute parenchymatous nephritis does not give so great a disturbance as chronic nephritis, especially if the latter is accompanied by a cardiac lesion, and this fact may serve in the diagnosis in the case where an acute nephritis develops in the course of an old or chronic renal lesion; and lastly, in cases with œdema, medicines (digitalis, diuretin, etc.) begin to provoke the polyuria with nocturnal predominance and, following, the quantity of night urine diminishes as the equilibrium in the circulation reappears.

Certowitch⁸ has presented the most recent work on the subject, and reports eighteen cases, confirming these results in the cardiac and renal cases and adds that the approach of asystole augments the night urine and as it regulates itself this is diminished. He also considers the cause of the disturbance and argues that, while the healthy man in full activity eliminates during the day 90 per cent. of fluid taken (Roger), and when confined in bed excretes 76 per cent. (André Marsin⁹), the subject of heart disease during failure of compensation, and the nephritic eliminate only 30 per cent. to 50 per cent. of liquid taken in, therefore the remainder accumulates in the body tissues and has a tendency to be excreted during the night, causing the polyuria.

The fifty-six cases here reported may furnish additional testimony to that already mentioned, as they illustrate some facts not brought out before, and also confirm some of the earlier work. This material was put in my hands¹⁰ by Dr. Dock, who, for a number of years, has ordered that all patients with albuminuria, diabetes, and heart disease, as well as some acute infections, shall have the urine divided into day and night portions. As stated above, 7 a. m. to 7 p. m. constitutes the day, and 7 p. m. to 7 a. m. the night. These periods of time were selected on account of nursing arrangements. Many cases could not be utilized, owing to errors in carrying out the measurements, or to the fact that patients did not remain long enough; but no selection was made.

⁷ *Loc. cit.*

⁸ *Loc. cit.*

⁹ *Thèse de Paris*, 99.

¹⁰ Dr. W. H. Morley was associated with me early in the research and aided largely in collecting the material before he found it necessary to give up the work.

To give some idea of the severity of the nephritis, figures will be found in the tables giving the amount of albumin present. These are obtained as follows, and can be only approximate, owing to variations from day to day. The test for albumin employed was heat and nitric acid, and if there was only a small amount present, it was described as a trace, cloud, or precipitate, as the case might be. If a larger amount was found, after the reaction was completed the test tube containing the urine was set aside for twenty-four hours, to allow the precipitate to settle, when the bulk of precipitate in the bottom of the tube was described as being a certain proportion of the amount of urine in the tube.

Certain other factors will be mentioned in the tables as having an influence upon the ratio, such as the presence or absence of œdema, of atheroma in the vessels, the condition of the heart in renal cases, the age of the patient, and medication.

In regard to the last named factor, the changes in ratio caused by various drugs do not seem to be very well understood at present. As was mentioned before, Laspeyres says that in cases of œdema, medicines, such as digitalis, diuretin, etc., at first cause polyuria with nocturnal predominance, but afterwards the quantity of night urine diminishes as the equilibrium in the circulation reappears. In my cases, given later, this statement does not seem to be verified. As will be pointed out, the nocturnal urine was increased many times, and in certain of the cases it did predominate (as it had before the drug was exhibited); but, on the other hand, the day urine was increased to a greater degree, so the final result was a change in the ratio toward the normal. There are two factors to be considered in this relation: first, and most important, is the drug; and, second, the time of administration. I think my tables will show clearly that diuretin increases the day urine most markedly and it may be taken as a type of those diuretics which act rapidly. Then, being administered during the day time, they exercise their effects most strongly during the day, and thus aid in restoring the normal ratio.

Digitalis may be taken as a type of the other class of drugs causing diuresis, which have a slower and more prolonged action. The figures obtained in the following cases, however, would indicate that their effects are much the same as diuretin, only less pronounced; in other words, they increase the nocturnal urine to a less extent than the day urine and therefore aid the normal ratio, but do not cause as great a disturbance in it as does diuretin.

Potassium acetate and Basham's mixture would be included in the digitalis group (as far

as our purposes here are concerned) as not being so active as the diuretin.

This question of the effect upon the ratio, of the different medicines and the time of their administration, however, is not very satisfactorily settled as yet, and I am carrying out, under Dr. Dock's direction, some further research upon the subject, administering them to patients with cardiac and renal disease, not only, as is commonly done, during the day time, but also at equal intervals during the twenty-four hours, and seeing what effect it will have upon the ratio; and I hope to be able to report later in greater detail upon this phase of the subject.

In the first three tables given herewith the figures do not include those days when diuretin was given, for the before named reason, but those days when digitalis, potassium acetate, and Basham's mixture were given, are included, and the drug used is indicated in the "Medication" column.

lation, as shown by a systolic murmur at the apex and slight œdema at the ankles. In the leucæmic case, No. 11 (Qd: Qn:: 34: 66) it is difficult to explain the great preponderance of Qn. The heart examination was negative and the nephritis not very severe. During the time of observation there was slight fever to about 101° F. usually, sometimes to 103°, with slight chills in the afternoon, but sweating was also often noted at night.

The case of diabetes insipidus (No. 8) is interesting in this connection, as the patient passed on the average over seven litres of urine in twenty-four hours, giving a perfectly normal ratio, 66: 34.

TABLE II.—ACUTE DISEASES.

From a study of Tables I and II it appears safe to conclude that a mild nephritis may not cause much disturbance; the ratio probably is changed, but in the acute diseases it has not passed the physiological limits excepting in the cases of scar-

TABLE I.—MISCELLANEOUS DISEASES.

| Number. | Case Number. | Diagnosis. | URINE. | | | | Albumin. | Casts. | Œdema. | Heart Examination. | Atheroma. | Age. | Result. |
|---------|--------------|-------------------------------|-----------|--------|--------|--------|----------|---------------------------|---------|-------------------------------|-----------|------|--------------|
| | | | Quantity. | | Ratio. | | | | | | | | |
| | | | Day. | Night. | Day. | Night. | | | | | | | |
| 1 | 229.99 | Gastric Carcinoma. | 475 | 520 | 48 | 52 | 1/6 | Granular, Hyaline. Waxy | 0 | Systolic murmur at apex. | + | 64 | Unimproved. |
| 2 | 50.01 | Hæmaturia. | 660 | 500 | 57 | 43 | Trace. | 0 | 0 | Negative. | 0 | 27 | " |
| 3 | 112.00 | Gastritis, Chr. | 200 | 375 | 35 | 65 | " | Hyaline. | 0 | Indistinct sounds. | M'k'd | 60 | Improved. |
| 4 | 286.00 | " | 313 | 200 | 61 | 39 | " | 0 | 0 | Negative. | 0 | 31 | Advised. |
| 5 | 120.98 | Arthritis " | 490 | 450 | 52 | 48 | " | 0 | 0 | Systolic murmur at pulmonary. | 0 | 25 | Improved. |
| 6 | 95.01 | Hypertrophic Cirrhosis Liver. | 288 | 264 | 52 | 48 | 1/2 | Granular. | 0 | Negative. | — | 43 | Not changed. |
| 7 | 213.98 | Pulmonary Tuberculosis | 270 | 395 | 41 | 59 | Trace. | Hyal., Gran., Epithelial. | 0 | " | 0 | 23 | " |
| 8 | 131.01 | Diabetes Insipidus. | 4700 | 2400 | 66 | 34 | Neg. | 0 | 0 | " | — | 32 | " |
| 9 | 365.00 | Leucæmia, mixed. | 575 | 485 | 54 | 46 | 1/4 | Gran and Hyaline. | 0 | " | — | 38 | " |
| 10 | 56.97 | " | 390 | 490 | 44 | 56 | 1/5 | " | Slight. | Systolic murmur at apex. | — | 43 | " |
| 11 | 73.00. | " | 282 | 538 | 34 | 66 | Cloud. | Leucocyte and Hyaline. | 0 | Negative. | — | 27 | " |

TABLE I.—MISCELLANEOUS DISEASES.

In this table of miscellaneous diseases with nephritis associated there is little disturbance of ratio except in Cases 1, 3, 7, 10, and 11.

In Cases 1 and 3 the nephritis, no doubt, accounts for part of the trouble, but probably a very important factor was the atheroma which was present in both, but was especially marked in No. 3. Atheroma itself may not be the important factor, but it indicates, or is associated frequently with, changes which cause the disturbance, as many times where the largest per cent. of nocturnal polyuria is present a greater or less marked degree of atheroma is found.

Case No. 7 (Qd: Qn:: 41: 59) may perhaps be explained by the nephritis alone, which appears to have been quite marked—granular, hyaline, and epithelial casts being found in the sediment. In Case 10 the renal conditions were not so marked, but there was a disturbance of the circu-

let fever. That we may see these changes better, we will take these cases up in greater detail later in the paper. (See Table IV.)

TABLE III.—RENAL AND CARDIAC DISEASES.

It would hardly appear necessary to give any further history of most of these cases, as the table gives the important points in the examination and treatment. A study of the details given would certainly confirm the contentions of the earlier workers, that in disease of the kidney and heart, there tends to be a disturbance of the ratio between day and night urine; this is slightly marked in acute nephritis and in chronic disease of the kidney, but is markedly changed when these are associated with cardiac disease, as, for instance, in Cases 33, 47, and 53.

The change may be more marked with disease of the myocardium but the one case here cited (No. 54) would of course not be enough to disprove or to add weight to that claim.

In certain of the cases here mentioned, it is rather hard to tell why the ratio is not disturbed more than it is; as, for instance, in Case 37 (Qd: Qn::71:29) with marked nephritis, œdema of the legs and sacral region, and slight general œdema of the skin. Here, perhaps, we should be justified in thinking the heart's efficiency was not much impaired. The examination on entrance showed "Shock rather strong, absolute dulness upper border fourth rib outside parasternal line. Just inside nipple is soft systolic murmur heard best in fourth I. C. S. inside parasternal line. Aortic second strongly accented." At a later examination "sounds were less murmurish." The heart then was hypertrophied and slightly uncompensated. This was restored during the stay in the hospital with a corresponding improvement in ratio, as will be shown later. The history of the case would bear out the same idea, that the main trouble was with the kidneys and not with the heart; the latter condition dating back, in all

Case No. 38 (Qd: Qn::61:39) also shows little change from the normal ratio, resembling No. 37 in that the history points to kidney disease of over one year's duration—no heart symptoms, and heart examination was negative. Case No. 41 showed albumin present only part of the time, as it would disappear for several days and then reappear. Special mention of the other cases hardly seems necessary, as they practically all show the same thing—a greater or less deviation from the normal ratio. In functional disease of the heart a normal ratio has been found to exist, so the observation of the relative proportions of day and night urine would aid in the diagnosis of this condition from an organic disease.

Beyond the aid to diagnosis, we may be assisted in following the course of a disease by noting the changes in ratio as the patient progresses toward recovery or the reverse. To do this, a fairly long observation of the case is necessary and due regard to certain factors, especially the medication,

TABLE II.—ACUTE DISEASES.

| Number. | Case Number. | Diagnosis. | URINE. | | | | Albumin. | Casts. | œdema. | Heart Examination. | Atheroma. | Age. | Result. |
|---------|--------------|---------------------|-----------|--------|--------|--------|----------|--------------------|--------|-------------------------------|-----------|------|------------|
| | | | Quantity. | | Ratio. | | | | | | | | |
| | | | Day. | Night. | Day. | Night. | | | | | | | |
| 12 | 214.02 | Croupous Pneumonia. | 225 | 140 | 62 | 38 | Trace. | Hyaline, Granular. | 0 | Rapid—weak. | 0 | 11 | Recovered. |
| 13 | 206.00 | Scarlet Fever. | 571 | 622 | 48 | 52 | " | " | 0 | Negative. | 0 | 12 | " |
| 14 | 205.00 | " | 562 | 626 | 47 | 53 | " | " | 0 | " | 0 | 10 | " |
| 15 | 207.00 | " | 520 | 605 | 46 | 54 | " | " | 0 | " | 0 | 13 | " |
| 16 | 208.00 | " | 631 | 554 | 53 | 47 | " | " | 0 | " | 0 | 7 | " |
| 17 | 111.02 | Typhoid Fever. | 490 | 405 | 54 | 46 | Neg. | 0 | 0 | " | 0 | 32 | " |
| 18 | 108.02 | " | 875 | 810 | 52 | 48 | " | 0 | 0 | Systolic murmur at pulmonary. | 0 | 32 | " |
| 19 | 71.02 | " | 1407 | 1147 | 55 | 45 | " | 0 | 0 | Sounds weak. | 0 | 23 | " |
| 20 | 115.00 | " | 915 | 852 | 52 | 48 | Cloud. | Many. | 0 | " | 0 | 58 | " |
| 21 | 22.97 | " | 566 | 463 | 55 | 45 | " | Hyaline, Granular. | 0 | Negative. | 0 | 21 | + |
| 22 | 59.02 | " | 780 | 450 | 63 | 37 | " | " | 0 | " | 0 | 20 | Recovered. |

probability, to an attack of acute inflammatory rheumatism four years before, but causing no special cardiac symptoms. The kidney condition, on the other hand, dated back only three months, from a cold, and on the evening of the day on which the patient caught cold his feet and legs were swollen for the first time, and since then he has always been troubled with them more or less. The œdema, then, was of renal origin, and would not cause so great a disturbance as if it had been due to the heart; but even so we should have expected a greater nocturnal polyuria from the nephritis, and why we did not get it, it would be hard to state. Lespeyres also reported some cases in which he did not get so great a predominance in nocturnal polyuria as he would have expected from the conditions present.

must be paid, mention being made particularly of diuretics. The changes caused by these have been discussed earlier and need not be taken up again here.

We give below some observations showing the changes as they take place, the cases referred to being those of scarlet fever recorded in Table II and some of the cases of nephritis and heart disease of Table III.

The scarlet fever occurred in one family, the children being from seven to thirteen years old. All the cases followed a typical course, making good recovery notwithstanding the mild parenchymatous degeneration of the kidneys. To see if any change in ratio took place during the course of the disease, examinations were made at short periods of a week or ten days, with the following results:

TABLE III.—RENAL AND CARDIAC DISEASES.

| Number. | Case Number. | Diagnosis. | URINE. | | | | Albumin. | Casts. | Edema. | Heart Examination. | Atheroma. | Age. | Medication. | Result. |
|---------|--------------|---|-----------|--------|--------|--------|----------|--|---------------------------|---|-----------|------|---------------------------------------|-------------|
| | | | Quantity. | | Ratio. | | | | | | | | | |
| | | | Day. | Night. | Day. | Night. | | | | | | | | |
| 23 | 126.99 | Acute Paren. Nephritis. | 782 | 562 | 58 | 42 | Trace. | Casts present at times. | 0 | Negative. | 0 | 18 | — | Improved. |
| 24 | 253.99 | Acute Paren. Nephritis. | 516 | 733 | 42 | 58 | " | Hyaline. | + | Apex 1" impure. Pulm. syst. murmur. | 0 | 17 | Basham's M. | " |
| 25 | 97.98 | Chr. Nephritis with acute exacerbations. | 955 | 965 | 50 | 50 | ½ | Hyal., Gran., Epithelial. | + | Sounds very weak. | — | 55 | Digitalis, nitroglycerin. | " |
| 26 | 90.02 | Chr. Paren. Nephritis. | 562 | 502 | 53 | 47 | ¼ | 0 | + | Syst. murmur at base. Apex 2" stronger than 1". | 0 | 20 | Basham's M. | " |
| 27 | 184.03 | Chr. Paren. Nephritis. | 233 | 534 | 30 | 70 | Trace. | Hyal., Gran., & Blood casts; much pus. | 0 | Negative. | 0 | 13 | Urotropin. | " |
| 28 | 8.02 | Chr. Paren. Nephritis. | 883 | 775 | 54 | 48 | ½ | Short and long Hyal. and Granular. | + | Systolic murmur over base. | + | 54 | — | " |
| 29 | 368.02 | Chr. Paren. Nephritis. | 585 | 612 | 49 | 51 | ½ | Hyal., Gran. | 0 | Systolic murmur at apex. | 0 | 18 | Potas. acetat. | " |
| 30 | 320.00 | Chr. Paren. Nephritis. | 419 | 527 | 44 | 56 | ½ | " " | 0 | Negative. | 0 | 18 | Basham's M. and Potass. acetat. | " |
| 31 | 111.01 | Chr. Paren. Nephritis. | 232 | 238 | 49 | 51 | ½ | 0 | 0 | Tachycardia (Post-diph.) | 0 | 24 | Strychnine. | " |
| 32 | 178.95 | Chr. Nephritis. | 508 | 468 | 51 | 49 | ¼ | Hyal., Gran., Waxy, Epithelial. | Gener'l | Aortic murmur. | 0 | 20 | Basham's M. | " |
| 33 | 52.02 | " " | 185 | 300 | 38 | 62 | Cloud. | Hyaline. | Gen'ral Anasarca. | Dullness enlarged, arrhythmia. Sounds weak, no murmurs heard. | + | 61 | Digitalis, strychnine. | Unimproved |
| 34 | 109.96 | Chr. Paren. Nephritis. | 577 | 962 | 37 | 63 | ½ | " All kinds." | Gener'l | Negative. | 0 | 35 | Basham's Mixt. | Improved. |
| 35 | 200.00 | Chr. Nephritis. | 920 | 939 | 49 | 51 | ¼ | Many Hyal., Gran., and cellular. | 0 | " | 0 | 27 | Basham's Mixt. | " |
| 36 | 301.00 | " " | 497 | 441 | 53 | 47 | Cloud. | Few Hyal. & Gran.. | 0 | " | + | 40 | Potas. acetate, caffeine. | " |
| 37 | 41.95 | " " | 1012 | 381 | 71 | 29 | ¼ | Hyal. Gran. Epithelial. | + Slight general | Absolute dullness enlarged. Mitral systolic murmur. | — | 21 | Digitalis. Basham's M. | " |
| 38 | 36.95 | " " | 500 | 315 | 61 | 39 | ½ | Hyal. some with granules. | Slight. | Negative. | — | 25 | Nitroglycerin. | " |
| 39 | 186.03 | Chr. Nephritis, Interstitial. | 670 | 835 | 45 | 55 | Trace. | Hyal., Gran. | 0 | Apex 5" I. C. S. 2 inches outside nipple. Aortic systolic murmur. | M'k'd | 60 | " | " |
| 40 | 65.01 | Chr. Nephritis, Interstitial. | 463 | 523 | 47 | 53 | ½ | Hyal., Gran., Leucocyte. | Ascites and mark'd Ced'ma | Apex 5" I. C. S. Dullness enlarged. Sounds impure. | " | 52 | Digitalis, nitroglycerin, strychnine. | + |
| 41 | 83.02 | Albuminuria. | 313 | 249 | 56 | 44 | ½ | Hyal., Gran. | 0 | Negative. | 0 | 22 | — | Improved. |
| 42 | 147.95 | Pyelonephritis | 465 | 675 | 41 | 59 | ¼ | Hyal., Gran., Leucocyte. | Ascites and Ced'ma | Mitral systolic murmur, arrhythmia. | — | 38 | Boric acid, etc. | Worse. |
| 43 | 258.01 | Nephrolithiasis. | 505 | 635 | 44 | 56 | ½ | Hyal., Gran. | 0 | — | — | 29 | Potass. acetate. | Improved. |
| 44 | 4.99 | Fibroid Heart. | 625 | 440 | 59 | 41 | Trace. | Hyal., Gran. and Leucocyte. | + | Dullness enlarged, arrhythmia. | — | 55 | Digitalis. | + |
| 45 | 111.03 | Mitral regurgitation. | 566 | 668 | 46 | 54 | ½ | Many Hyal. & Gran. | + | Dullness enlarged. Mitral systolic murmur, arrhythmia. | + | 51 | Digitalis, nitroglycerin. | Improved. |
| 46 | 136.02 | Ascites, Mitral regurgitation. | 323 | 200 | 62 | 38 | Neg. | Hyal., Granular. | Ascites and Ced'ma | Mitral systolic murmur, arrhythmia. | 0 | 57 | Helleborein. | " |
| 47 | 274.03 | Mitral regurgitation and stenosis | 248 | 612 | 29 | 71 | ½ | Hyal., Gran., Leucocyte. | 0 | Dullness enlarged. Apex 5" I. C. S. outside nipple. Mitral systolic murmur. Arrhythmia. | + | 64 | Digitalis, Potas. acetate. | " |
| 48 | 118.00 | Double aortic, Double mitral, Hypertrophy and dilatation. | 590 | 862 | 41 | 59 | Cloud. | Hyal., Gran., Leucocyte. | 0 | Apex, 6" I. C. S., anterior Axillary line. Dullness enlarged. | 0 | 32 | Nux vomica. | +(apoplexy) |
| 49 | 56.00 | Double aortic, Mitral regurgitation. | 200 | 220 | 48 | 52 | ½ | Hyal., Gran., Leucocyte. | + | Heart dilated. Murmurs over heart, no localized apex. | + | 57 | Digitalis, strychnine, nitroglycerin. | + |
| 50 | 281.00 | Aortic regurgitation, Mitral stenosis. | 262 | 367 | 42 | 58 | Cloud. | Granular. | 0 | Arrhythmia. | + | 53 | Digitalis, nitroglycerin. | Unchanged. |

| | | | | | | | | | | | | | | |
|----|--------|---|-----|------|----|----|--------|---------------------|--------|--|---|----|---------------------------|-----------|
| 51 | 122.01 | Mitral regurgitation, Aortic stenosis. | 856 | 585 | 59 | 41 | Neg. | 0 | + | Heart enlarged. Mitral and aortic systolic murmurs. | + | 72 | Nitroglycerin. | Improved. |
| 52 | 129.96 | Dilatation, atheroma. | 201 | 284 | 41 | 59 | 3/10 | 0 | - | Slight dilatation of left ventricle. | + | 62 | Nux vomica. | " |
| 53 | 286.99 | Mitral regurgitation. Pleurisy with effusion. | 598 | 1044 | 37 | 63 | 1/2 | Hyal., Gran., Waxy. | + | Mitral systolic murmur. | + | 31 | Basham's M. Digitalis. | " |
| 54 | 193.03 | Mitral regurgitation. Myocarditis. | 345 | 410 | 46 | 54 | Trace. | " " | + | Apex 6" I. C. S., 1" outside nipple. Gallop rhythm. Apex 1" sound impure. | 0 | 32 | Digitalis, strophanthus. | " |
| 55 | 20.97 | Anasarca, Hypertrophy of left ventricle. | 436 | 400 | 52 | 48 | 1/4 | " All kinds." | Marked | Apex 6" I. C. S. Foetal rhythm. No murmurs heard at first; later, mitral systolic. | + | 50 | Digitalis, nitroglycerin. | + |
| 56 | 50.95 | Mitral stenosis. | 570 | 515 | 52 | 48 | 0 | 0 | Trace. | Arrhythmia. Mitral diastolic murmur at times. | - | 30 | Strychnine. | Improved. |

TABLE IV.—SCARLET FEVER.

| Days observed. | Urine, | | Albumin. |
|----------------|----------|--------------------|-------------------------|
| | Quantity | and ratio. | |
| CASE 15: | IO | 580: 550:: 51: 49 | "Negative" to "trace." |
| | II | 465: 650:: 42: 58 | "Trace" to "cloud." |
| CASE 13: | IO | 840: 710:: 54: 46 | "Trace." |
| | IO | 390: 527:: 43: 57 | "Trace." |
| | IO | 357: 655:: 35: 65 | "Faint cloud." |
| | 7 | 750: 670:: 53: 47 | "Faint cloud" to "neg." |
| CASE 16: | IO | 895: 580:: 61: 39 | "Trace." |
| | IO | 567: 600:: 49: 51 | "Cloud." |
| | 15 | 495: 505:: 50: 50 | "Faint cloud." |
| CASE 14: | IO | 872: 1132:: 44: 56 | "Trace." |
| | IO | 464: 336:: 58: 42 | "Trace." |
| | 15 | 410: 450:: 48: 52 | "Trace" to "negative." |

In thus examining these cases for the shorter periods we see the changes in ratio taking place which resulted in those given in Table II. As the kidney lesion progressed, the proportion of night urine rose, and finally, as improvement came on with the disappearance of albumin, a readjustment backward toward the normal took place. In Case No. 14 the ratio is more irregular than in the others, but no explanation can be given for this. By studying the cases in this way we can see the changes caused by the disease more clearly, although, as mentioned, they are not so marked as we get in some other conditions. In the typhoid cases it was not possible to watch the changes as we could in the scarlet fever, because the albumin and casts were either present or absent in a certain case when the urine began to be measured separately, and continued about the same during the whole course of the disease.

From Table III we give the following cases:

| | | | |
|----------|--|-----------------|-----------|
| CASE 25. | Chronic parenchymatous nephritis with acute exacerbations. | | |
| Days. | Urine. | Medication. | Result: |
| 5 | 1080: 1190:: 48: 52 | Nitroglycerin | Improved. |
| 5 | 830: 740:: 53: 47 | and digitalis. | |
| CASE 29. | Chronic nephritis, anæmia, epilepsy. | | |
| 7 | 575: 565:: 50: 50 | Potas. acetate. | |
| 6 | 595: 660:: 48: 52 | Potas. acetate. | |

Result: General condition improved, but there was more albumin in urine at end than at the beginning of the observations.

CASE 31. Chronic paren. nephritis, postdiphtheritic tachycardia, partial paralysis of throat.

| | | |
|----|-------------------|---------------------|
| IO | 205: 270:: 43: 57 | Strychnine. |
| IO | 227: 195:: 54: 46 | Strychnine. |
| 12 | 258: 248:: 51: 49 | Strychnine stopped. |

General improvement.

NOTE.—The last ratio will be noticed as not quite so favorable as the former—this has been noticed in several of the cases, and is probably due to the patient, as he improved, moving about more, which has a tendency to increase the nocturnal urine.

CASE 32. Chronic nephritis.

| | | |
|----|-------------------|-------------------|
| 8 | 425: 564:: 43: 57 | Basham's mixture. |
| 10 | 283: 352:: 45: 55 | Basham's mixture. |
| 12 | 661: 493:: 57: 43 | Basham's mixture. |
| 7 | 594: 529:: 53: 47 | Basham's mixture. |

Gradual improvement with few exceptions during whole case. See Note Case 31.

CASE 34. Chronic paren. nephritis.

| | | |
|----|--------------------|--------------------|
| 6 | 375: 640:: 37: 63 | Strontium lactate. |
| 16 | 605: 1015:: 37: 63 | Strontium lactate. |
| 11 | 500: 1015:: 33: 67 | Basham's mixture. |
| 8 | 680: 1085:: 39: 61 | Basham's mixture. |
| 16 | 620: 1060:: 37: 63 | Basham's mixture. |

Here we get very little change in ratio, only a slight improvement, which corresponded with some improvement in the general condition. There was a good deal of œdema present and much albumin in the urine when the patient went home. Heart examination was negative. It will also be noted that Basham's mixture caused very little diuresis.

CASE 35. Chronic paren. nephritis.

| | | |
|----|---------------------|---|
| 10 | 875: 959:: 46: 54 | |
| 15 | 1092: 1097:: 50: 50 | Basham's mixture. |
| 16 | 835: 788:: 52: 48 | Basham's mixture and strontium bromide. |

Improved.

CASE 36. Chronic paren. nephritis.

| | | |
|----|-------------------|----------------------------|
| 17 | 537: 558:: 49: 51 | Caffeine, potass. acetate. |
| 18 | 435: 329:: 57: 43 | Caffeine, potass. acetate. |

Improved.

CASE 37. Chronic paren. nephritis.

| | | |
|----|--------------------|------------------------------|
| 6 | 897: 351:: 72: 28 | |
| 8 | 1171: 422:: 74: 26 | Digitalis. |
| 11 | 1118: 373:: 75: 25 | Digitalis. |
| 8 | 828: 350:: 71: 29 | Digitalis. See Note Case 31. |

Improved.

(This case was discussed in detail earlier in the paper.)

CASE 40. Chronic interstitial nephritis, atheroma.

| | | |
|---|-------------------|------------------------------|
| 2 | 250: 500:: 33: 67 | Digitalis and nitroglycerin. |
| 4 | 530: 520:: 50: 50 | Diuretin and nitroglycerin. |
| 5 | 390: 415:: 48: 52 | Digitalis and nitroglycerin. |
| 6 | 500: 633:: 36: 64 | Digitalis and nitroglycerin. |
| 7 | 850: 890:: 49: 51 | Diuretin and nitroglycerin. |
| 9 | 630: 610:: 52: 48 | Strychnine. |
| 6 | 445: 425:: 51: 49 | Strychnine. |
| 6 | 220: 265:: 45: 55 | Strychnine. |

Died.

This case shows the changes caused by medication very well. When the patient entered the hospital he was placed on digitalis and nitroglycerin and kept on these about two weeks; his ratio was 33:67 at the end of this period. Under diuretin the day urine was most markedly increased and the ratio became 50:50. When diuretin was stopped, the proportion of day urine fell gradually to practically the same point at which it was when the patient entered. Under a second course of diuretin it came back to 49:51, and remained there for a week after the drug was stopped and strychnine substituted, after which the night proportion rose gradually and the day proportion fell until death occurred. This illustrates the action of diuretics like diuretin, which act rapidly and, when administered only during the day time, as is commonly done, increase the day urine most markedly.

CASE 45. Mitral regurgitation, arteriosclerosis, chronic nephritis.

| | | |
|----|-------------------|-------------------------------------|
| 5 | 550: 730:: 43: 57 | Diuretin, digitalis, nitroglycerin. |
| 10 | 600: 730:: 45: 55 | Diuretin, digitalis, nitroglycerin. |
| 4 | 433: 580:: 43: 57 | Diuretin, digitalis, nitroglycerin. |

Result: During first two periods there was improvement. During the last period the patient was much worse; he was unable to lie down and there was marked cardiac arrhythmia. By some error the separation of urine in the case was stopped at this point. As will be seen, with the change for the worse in the condition came also a less favorable ratio. The patient died two weeks later.

CASE 46. Mitral regurgitation, ascites, chronic nephritis.

| | | |
|---|-------------------|--------------|
| 8 | 310: 365:: 54: 46 | Helleborein. |
| 8 | 335: 135:: 71: 29 | Helleborein. |

Improved.

CASE 50. Aortic regurgitation, mitral stenosis, chronic interstitial nephritis, enlarged spleen.

| | | |
|---|-------------------|------------------------------|
| 7 | 254: 475:: 35: 65 | Digitalis and nitroglycerin. |
| 7 | 310: 364:: 46: 54 | Digitalis and nitroglycerin. |
| 9 | 231: 264:: 47: 53 | Digitalis and nitroglycerin. |

Improvement in ratio, but not in general condition.

CASE 51. Mitral regurgitation, arteriosclerosis, chronic interstitial nephritis.

| | | |
|---|--------------------|----------------|
| 5 | 680: 490:: 58: 42 | Nitroglycerin. |
| 5 | 1120: 825:: 58: 42 | Nitroglycerin. |
| 7 | 796: 410:: 66: 34 | Nitroglycerin. |

Improved.

CASE 54. Mitral regurgitation, myocarditis, chronic parenchymatous nephritis, chronic gastritis.

| | | |
|---|-------------------|------------------------------|
| 5 | 240: 570:: 30: 70 | Digitalis. |
| 6 | 445: 455:: 49: 51 | Digitalis and strychnine. |
| 9 | 320: 403:: 44: 56 | Strophanthus and strychnine. |
| 8 | 310: 340:: 48: 52 | Strophanthus and strychnine. |

Improved.

CASE 55. Arteriosclerosis, contracted kidney, hypertrophy of left ventricle, anasarca, nephritis.

| | | |
|---|-------------------|------------|
| 6 | 334: 397:: 46: 54 | Digitalis. |
| 6 | 449: 385:: 54: 46 | Digitalis. |
| 5 | 764: 527:: 59: 41 | Digitalis. |
| 2 | 550: 450:: 61: 49 | Digitalis. |

Died.

This case is one which does not follow the rule as laid down by the previous cases. The patient gave a history of obscure symptoms on the part of the liver, pain in that region, and occasional jaundice for over eleven years. There was irregularity of the heart, with swelling of the legs and abdomen, for two years, so that he could not work for some months. Five months before his entrance to hospital he became short of breath and thinks he was jaundiced. Four months before entrance, he had pain in the back and frequent micturition, especially at night, swelling of the legs, etc. Examination at hospital showed "No cyanosis or jaundice, large amount of œdema in back and below wrist; Cheyne-Stokes respiration, heart dilated, no murmurs heard; foetal rhythm; liver and spleen enlarged." As is shown in the table, the ratio improved during his entire stay in the hospital, and so apparently did the patient until a few days before the end. The œdema grew softer and the heart became stronger, so that a loud systolic murmur was heard at the apex. While, however, the urinary ratio continued to improve, the patient took a turn for the worse, cyanosis increased, Cheyne-Stokes respiration reappeared, the heart dilated, and the patient died about a week later. Why this change was not reflected in the urinary condition cannot be stated, and this one case stands alone in the whole number as an apparent exception.

From a study of these observations we can conclude, as mentioned before, that the changes in a certain case from or toward the normal ratio are but expressions of the changes which take place in the patient's renal or cardiac condition, and therefore they can be used as an index to his progress. Certowitch noted this fact in one of his cases.

To make a brief summary of the results obtained in this study, I would (1) confirm the earlier writers' views as to the nocturnal polyuria occurring in renal and cardiac disease. (2) Point out the value of this fact as a diagnostic sign, especially in cardiac disease.

I would add (1) the possibility of tracing the course of a nephritis or of a cardiac disease by observing the changes in the relative amounts of day and night urine for short periods of time, and (2) when drugs which cause diuresis are administered during the day they tend to restore the normal ratio.

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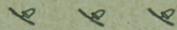
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