situation of the pain, (*b*) by the presence of blood or pus in the urine, and (*c*) the absence of jaundice in this or a former attack.

From *Dietl's crisis* (severe colicky pain occurring in connection with floating kidney), renal colic is distinguished by the absence of abnormal mobility of the kidney and by the situation and course of the pain.

In *intestinal colic* the pain shifts its position frequently and is associated with noises produced by wind in the bowels, or with diarrhœa or constipation.

Renal pain, not colic, occurs in almost any disease of the kidney *except nephritis*, and is characterized by its situation over the anatomical seat of the kidney and by the lack of any connection with muscular movements (lumbago) or with spinal movements (hypertrophic arthritis).

I have now described what seems to me most important in the *local external* examination for kidney disease, and have mentioned, along with the different lesions producing tumor, the general constitutional manifestations which are of assistance in diagnosis. Aside from the *local* and the *constitutional* evidence of renal disease, we have only the evidence afforded by the urine, to which I now pass on.

Examination of the Urine.

The urine as passed per urethram is a resultant and reflects the influence of many different organs and surfaces. Thus disturbances of metabolism, such as diabetes, intoxications (lead, arsenic), diseases of the heart, liver, and intestine, febrile conditions, infective or malignant disease of any part of the urinary tract (kidney, ureter, bladder, or urethra), as well as the different types of nephritis, all affect the urine, though hardly any of them produce pathognomonic changes in it. In this section I shall consider the urine as a piece of evidence in the diagnosis of kidney disease, and only in contrast with this will its characteristics in extrarenal troubles be mentioned briefly.

The most essential features of the urine in the diagnosis of kidney disease are:

1. The amount passed in twenty-four hours, measuring separately the portions passed at night (8 P.M. to 8 A.M.) and in the daytime (8 A.M. to 8 P.M.).
2. The specific gravity.
3. The looks (optical properties).
4. The reaction to litmus.

Much less important than these are the microscopic and chemical examinations (albumin, casts, etc.).

The Amount and Weight of the Urine.

The twenty-four-hour amount concerns us chiefly in diabetes and the different types of nephritis.

Polyuria occurs in health after the ingestion of large quantities of water, and sometimes in conditions of *nervous strain*. In disease it characterizes both forms of *diabetes*, *cirrhotic kidney* (primary, secondary, or arterio-sclerotic), and is seen during the *convalescence from acute nephritis and from various infectious diseases*. In diabetes of either form several quarts or even gallons may be passed. In cirrhotic kidney the increase of urine occurs very largely at night, so that the amount may be double that passed in the daytime, just reversing the conditions of health.

Oliguria or scanty urine occurs in health when the amount of water ingested is small or when water is passed out of the body abundantly through the skin or by the bowels (diarrhœa). In disease oliguria or absolute suppression of urine (*anuria*) occurs at the beginning of *acute nephritis* and as a result of occlusion of one or both ureters by *stone or malignant disease*.[1] Remarkable examples of anuria also occur in *hysteria*. *Infectious fevers and cachectic states* often diminish the secretion of the urine by one-half or more.

The *specific gravity* is usually low with polyuria and high with oliguria, but in diabetes mellitus the presence of the sugar gives us polyuria with high specific gravity.

Total Urinary Solids.—By multiplying the last two figures of the specific gravity by the number of ounces of urine passed in

[1] It is a remarkable but well-attested fact that when one ureter is suddenly blocked both kidneys may stop secreting for the time. Yet when one kidney is gradually destroyed as in tuberculosis, the other hypertrophies so as to assume the function of both.

twenty-four hours and the product by 1.1, we get a figure representing the total urinary solids in grains, with accuracy sufficient for clinical diagnosis. Thus if 30 ounces of urine are passed in 24 hours and the gravity is 1.020, then $20 \times 30 \times 1.1 = 660$ grains. The significance of this figure will be discussed later (see page 428).

Optical Properties.

Color.—Dilute urines (polyuria) are generally pale, and concentrated urines (oliguria) high in color. A dark or brownish tint in the urine is generally produced by bile, by blood pigment, or as a result of certain drugs—carbolic acid, coal-tar preparations, and salol. If the color is due to bile, a bright canary yellow appears in the foam after shaking up a little of the urine in a test tube. No other tests for bile are necessary. Urines darkened by blood pigment show abundant blood corpuscles in the sediment;[1] when the color is due to drugs we can usually learn this fact from the history.

Turbidity in alkaline urine is usually due to the presence of bacteria. In acid urine it is produced in a great majority of cases by amorphous urates, and disappears on heating the urine, while the turbidity due to bacteria is unaffected by heat. Normal urine may be turbid and alkaline, owing to the presence of insoluble carbonates and phosphates, but clears on the addition of acetic acid. Hence turbidity, not removed by heat or acetic acid, is almost always due to bacteria, *i.e.*, to cystitis, pyelonephritis, or both.

Shreds seen floating in the urine are presumptive evidence of urethritis, and practically always of gonorrhœa.

The *gross sediment* as seen by the naked eye amounts in health to nothing more than a slight cloud, which settles in the lower part of the vessel containing the urine. This cloud is somewhat denser in women than in men, owing to the presence of vaginal detritus. When the gross sediment amounts to anything more than this, it is almost invariably made up of (*a*) *pus*, (*b*) *blood*, or (*c*) *urates*. The latter are dissolved on heating. Pus has usually its ordinary yellow color and general appearance. Blood may be somewhat

[1] Except in some cases of hæmoglobinuria.

lighter or somewhat darker than under ordinary conditions, but is usually recognized without difficulty.

Significance of these Sediments.—A *urate sediment* means nothing more than a concentrated urine standing in a cold room. In the winter-time patients often bring us, in great alarm, a bottle of milky or fawn-colored and turbid urine, which is not in any way abnormal. The urates have been precipitated over night by the low temperature of the bedroom.

Pyuria, or gross pus in the urine, is oftenest seen in cystitis and next often in pyelonephritis and renal suppurations. The pus occurring in gonorrhœal urethritis is usually much less in quantity than that coming from the bladder or kidney, and can be distinguished by the local signs of gonorrhœa. Leucorrhœal pus can be excluded by withdrawing the urine by catheter. The rupture into the urinary passages of an abscess from the prostate or any part of the pelvis may produce a profuse but transient pyuria.

After excluding gonorrhœa, leucorrhœa, and abscess, which can usually be done with the help of a good history and a catheter, we have left *cystitis* and *renal suppurations*, which it is very important and sometimes difficult to differentiate. In both we have the frequent and painful passage of small quantities of a urine which is in no way remarkable except in containing large amounts of pus and bacteria.

In many cases the differentiation may be accomplished as follows: Have the patient save for twenty-four hours the urine voided at each passage *in a separate bottle* (all of the bottles being of uniform size), and mark each bottle with the hour at which it was filled. Then arrange the specimens in a row, beginning with that passed earliest and ending with that passed last. Now if the case is one of cystitis without involvement of the kidney, the amount of pus that settles is practically the same in each bottle (allowing for differences in the amount of urine in the different bottles). But if the pus comes from the kidney, it is almost always discharged intermittently, and hence some of the bottles will be almost free from sediment, while in a group of the others the amount of pus increases as we pass along the line, reaches a maximum in one or two bottles, and decreases again in those representing the later acts of micturition.

Pus from the bladder is generally alkaline, although in tuberculosis it may be acid; pus from the kidney is generally acid. When both organs are involved, as is frequently the case, we have a mixture of the characteristics of both types of pyuria, and cystoscopic examination with or without catheterization of the ureters is usually necessary.

In *renal pyuria* we often have local signs in the renal region (tumor and tenderness), a history of renal colic, and decided constitutional symptoms.

In *vesical pyuria* we have vesical pain, often tenesmus, no renal pain or tumor, and usually slighter constitutional symptoms. The amount of squamous epithelium (see below) is sometimes larger in cystitis than in renal suppurations, but no reliable inferences can be drawn from the size or shape of the cells.

To determine whether pus from the bladder or the kidney is tuberculous or non-tuberculous in origin, we usually inject the sediment into a guinea-pig, which develops tuberculosis or not according to the nature of the pus injected. This method is much more reliable than the bacteriological examination of the sediment, for besides the tubercle bacillus other bacilli which retain fuchsin and resist decolorization by strong mineral acid and by alcohol occasionally occur in the urine.

Hæmaturia.—In searching for the source of the blood we must be sure to exclude the female genital organs. Menstrual blood and uterine bleeding from various other causes often contaminate the urine, and must be excluded by using a catheter.

The causes of true hæmaturia, arranged approximately in the order of frequency, are:

1. Early cystitis.
2. Stone in the kidney (less often vesical stone).
3. Acute nephritis and acute exacerbation of chronic nephritis.
4. Tumors of the kidney or bladder.
5. Tuberculosis of the kidney or bladder.

Less common causes are: floating kidney, acute infectious fevers (malaria, smallpox), animal parasites in the urinary passages, poisons (turpentine, carbolic acid, cantharides), hemorrhagic diseases

(purpura, scurvy, leukæmia), trauma and renal infarction, angioneurotic and other mystical conditions.

In *cystitis* there are bladder symptoms—pain, tenesmus, frequent and painful micturition. The blood is mixed with pus and epithelium, and is especially abundant in the urine passed near the end of the act of micturition. If the bladder is irrigated it is hard to get the wash-water clear.

In *renal stone* there are no bladder symptoms to speak of, the blood is pure and thoroughly mixed with the urine, and if the bladder is washed out the final wash water is clear. There is often renal colic (see below) and sometimes the passage of stones or gravel by urethra.

In *acute nephritis* the blood is rarely fresh, generally dark chocolate in color. The twenty-four-hour amount of urine is small, and albumin and casts (see below) are abundant. General œdema is common. Local symptoms in the kidney or bladder are absent.

In *renal tumor* or *tuberculosis* we have often pyuria and the local and constitutional evidences above described (page 416), with an absence of bladder symptoms (provided the bladder is not also diseased).

Tumors of the *bladder* need cystoscopy for diagnosis.

In the diagnosis of the rarer forms of hæmaturia we rely chiefly on the history (trauma, poisons ingested) and on the evidences afforded by general physical examination.

Chemical Examination of the Urine.

1. Reaction of Normal Urine.

The reaction of normal urine is acid to litmus, except temporarily after large meals. Its acidity becomes excessive in fevers or occasionally without any known cause.

Alkaline urine has generally an ammoniacal odor and suggests cystitis. As a result of decomposition and bacterial fermentation all urine becomes alkaline (ammoniacal) on standing exposed to air.[1]

[1] Simultaneously a dark-brown color rarely appears: *alkaptonuria*, a fact